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Temporal and spatial distribution, and flight directions of migratory birds in Tsavo West National Park, Kenya: a comparison of radar and ringing data

Herbert Stark, Tabitha Njokikanuri, David Pearson†, and Felix Liechti

Summary

From 1 November 2013 to 30 April 2014 an avian radar system was operated in Tsavo West National Park, Kenya. The aim of this research was to study the temporal and spatial distribution of migrating birds over Ngulia Safari Lodge and to compare radar data with catching results of grounded birds. Additionally, the general pattern of flight directions during the six-month season is shown. From 25 November to 12 December 2013 more than 21 000 birds of 29 species were caught and ringed under misty conditions, supported by floodlights and sound luring (Pearson 2013). A total of 8564 individuals (41%) were caught during the night. The majority of the birds were Marsh Warblers *Acrocephalus palustris* (4442 ringed) and Thrush Nightingales *Luscinia luscinia* (2719). Radar data of bird migration intensities (migration traffic rates, MTR = birds/km/h) show an increase in late November to December, decreasing towards February and rising again in March and April when birds are migrating north to their breeding grounds in Eurasia. These MTRs correlate very well with the numbers of birds on the ground. They also show that birds are still migrating under clear, mist-free conditions, when no attempts were undertaken to catch birds. As expected, the flight directions changed from south in the autumn, to north in March and April. The support of the wind is optimal for migrating birds. At the lower altitudes the wind direction changes from northeast (November – January) to southeast (March, April), thus supporting migrating birds with optimal tailwinds. This means that birds are not obliged to change their flight altitude between seasons. The wind support originated in the calm Intertropical Convergence Zone and is optimal throughout the season from November to April. To our knowledge this is the first time that a study has shown the magnitude of bird migration in eastern Africa and the temporal and spatial distribution for half a year.

Keywords Palaearctic migration, radar, Kenya

Introduction

The catching and ringing of birds during the migratory season has been used to indicate the intensity of day-by-day migration and the seasonal phenology (Jenni 1984, Karlsson *et al.* 2002, Korner-Nievergelt *et al.* 2007). The number of birds caught is often used to monitor population size and demographic parameters (Baillie *et al.* 1999,

Spina 1999, Peach *et al.* 1999, Dunn & Ralph 2004). Variation in numbers of long-term ringing programmes and the involved phenology have often been assessed in the literature over the years with the aim of examining the effect of climate change on bird migration (Hüppop & Hüppop 2003, Jenni & Kery 2003, Vickery *et al.* 2007, Hušek & Adamík 2008). Numbers caught, however, have limitations because of biases in sampling methods. When assessing daily migration intensity by looking at the numbers caught, it is assumed that the number of birds caught is a quantitatively representative sample of the birds migrating over the netting site. A close relationship between the numbers caught and the migration intensity in the air above may be more likely at sites where birds are caught from active migration, for example on an alpine pass with virtually no stopover possibilities (Komenda-Zehnder *et al.* 2010). However, a less close relationship might be found at stopover sites where birds stay in appropriate habitats to refuel for several days, as found at the Lake Constance reed beds in northeastern Switzerland (Stark *et al.* in prep.). It is nevertheless still an open question whether the numbers of migrants caught reflect the numbers passing over. Birds typically fly at far higher altitudes than the height of mist nets. Until now, few studies have investigated whether numbers captured and ringed are quantitatively representative of migration intensities (Peckford & Taylor 2008). At Falsterbo, in southern Sweden, Zehnder & Karlsson (2001) found a good correlation between daily numbers caught and nocturnal migratory intensity of the preceding night. These were measured with an infrared system at the Falsterbo Bird Observatory. Simons *et al.* (2004) found a correlation of migratory peaks observed by weather surveillance radar, mist netting and morning censuses at the north coast of the Gulf of Mexico, USA, while Peckford & Taylor (2008) reported a positive correlation between ground counts and numbers of birds tracked with radar the night before at a coastal site in Nova Scotia, eastern Canada.

To our knowledge, until now, all studies comparing catching data with migration intensities have been performed at coastal sites. Furthermore, in these studies the comparisons were restricted to nocturnal counts of flying birds and diurnal captures or counts on the ground. However, appearances of grounded birds are not always a good reflection of the strength of migration overhead and it is unlikely that large scale movements out of Ethiopia, for example, would be much influenced by local conditions many hundreds of kilometres to the south (Pearson 1990).

Bird migration south of the equator is dominated by a small number of Palaearctic species. Forty-four passerine species commonly reach the equator and 21 of these extend their migrations further, to winter mainly, or in part, from 5° S to 25° S (Pearson *et al.* 1988), thus effectively following the intertropical rain belt and benefitting from humid conditions during most of their stay on the continent. These migrations, between the Palaearctic and southern Africa, typically with an approximate distance between 6000 and 10 000 km, include some of the longest passerine journeys known. In our study we compared the numbers of birds ringed in Tsavo West National Park, Kenya, with the migration intensity determined simultaneously by radar. The ringing station and the radar station were situated at the Ngulia Safari Lodge. Thus, it was possible to see whether or not catching numbers correlate with migration intensity or not, and this is crucial in the analysis and interpretation of this huge data set. Moreover, at this site, actively migrating birds are caught mainly during the night and morning hours, and there is, in general, no netting during the afternoon.

Study site, methods and materials

This study was conducted at Ngulia Safari Lodge (3°00′S, 38°13′E, altitude 920 m) in Tsavo West National Park (Fig. 1) from 1 November 2013 to 30 April 2014. Ngulia Lodge is sited above a 300-m escarpment overlooking plains to the east and backed to the south by the Ngulia ridge (rising to 1821 m). This site was chosen because on misty nights, from late October to January, thousands of night-migrating birds, which have nested in Europe and Asia on their way to destinations further south, are attracted to the lodge's bright game-viewing lights (Pearson & Backhurst 1976). The attraction of the lights is lessened when the moon is up. The 'lighthouse effect' of Ngulia was discovered in 1969, soon after the lodge was built, and since then a team of ornithologists, the Ngulia Ringing Group (NRG), has come to Ngulia each year to study the phenomenon using ringing and other techniques. If there is mist and little or no moonlight, night migrants are attracted in their thousands to strong flood lamps around the lodge. Sometimes huge 'falls' remain at dawn, especially if drizzle or showers occur at night. To our knowledge, this is the first study to involve a bird radar south of the equator. This radar system is automatically operated and provides the opportunity to examine temporal and spatial bird migration.

Throughout this paper, the seasonal terms 'spring', 'summer', 'autumn' and 'winter', refer to the boreal seasons.

Figure 1. Location of Ngulia Safari Lodge in Tsavo West National Park, Kenya.

Based on a marine radar, the Swiss Ornithological Institute (SOI) has developed a bird radar (Fig. 2) with a parabolic dish which produces a very narrow beam with an opening angle of just 2 degrees. The antenna can be positioned at different elevations (0 to 85 degrees) and also in the azimuth within a certain range (0 to 270 degrees). The radar was operated at 25 kW in short pulse mode. Every moving item crossing this beam produces an echo and is registered in the database.

The direction of bird migration in Tsavo West NP is expected to be north–south in the Palaearctic autumn and vice versa in the Palaearctic spring. To scan a maximum number of birds, the radar beam should be directed nearly perpendicular to the expected flight direction of the birds. For this reason, and also for avoiding clutter from landscape structures, the radar beam was directed in two directions, 95° east and 45° northeast. For each azimuth, alternating every half hour, six elevations (11°, 17°, 28°, 34°, 45° and 68°) were used to monitor bird movements.

Figure 2. Fixed-beam radar: Birdscan MT1 at the Ngulia Safari Lodge (photo: M. Schaad).

Tailor-made software, Fixbeam, was used for the evaluation of the collected radar data, but the following points need to be taken into account:

1. All clouds from rain or heavy fog have to be extracted manually. This was done continuously during the fieldwork.
2. The software automatically detects all echoes. These data are then entered into a Microsoft Access database.
3. A training dataset had to be established manually to program the software to be able to differentiate between bird echoes and echoes resulting from clutter.
4. With this training dataset, the software then verified all sampled echoes and classified them into four groups: passerines, waders, swifts or unidentified birds (see Fig. 3 to Fig. 6).
5. With these classified bird echoes, the migration traffic rate (MTR) was then calculated by MS Access, which subsequently showed how many birds cross a line of 1 km in one hour. These MTR values form the basis of the following analysis related to the temporal and spatial distribution of migrating birds over Tsavo West National Park.

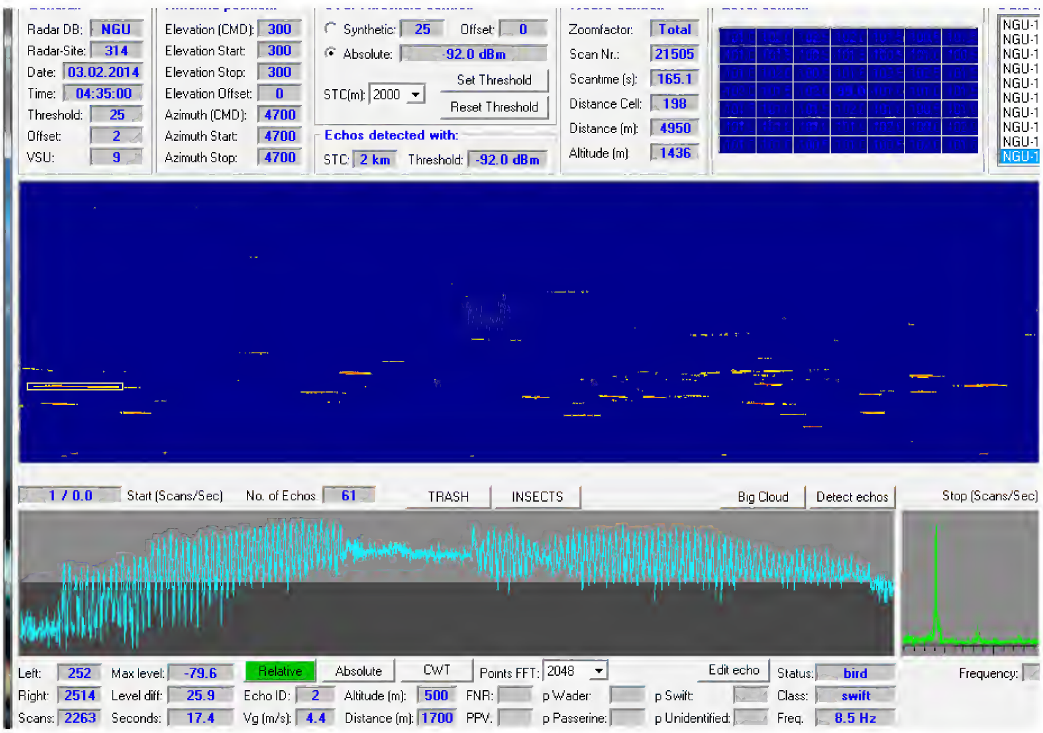

Figure 3. Display of Fixbeam software showing one measurement from 3 February 2014, 04:35, (time on the x-axis, 215 s), distance of the echoes on the y-axis, maximum 6 km. Each line (mostly coloured in red) shows an echo. The details of a marked echo (white frame) are shown in the frames below the blue frame. Within the dark grey frame the wingbeat pattern for the marked echo is shown. The wingbeat frequency (8.5 Hz) is shown in the frame to the right. This echo was detected at 1700 m distance at an altitude of 500 m above ground level and was defined as a swift species. Altogether 61 echoes were detected during this measurement.

Figures 4–6 below show typical examples for wingbeat patterns.

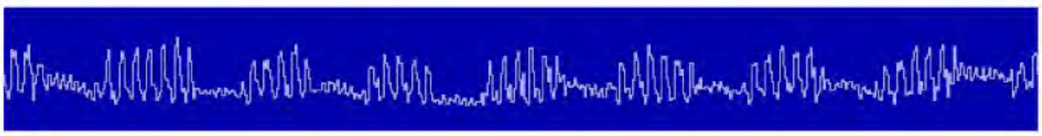

Figure 4. Typical pattern for passerine-like birds with regular beating phases and pauses, wingbeat frequency 12 Hz.

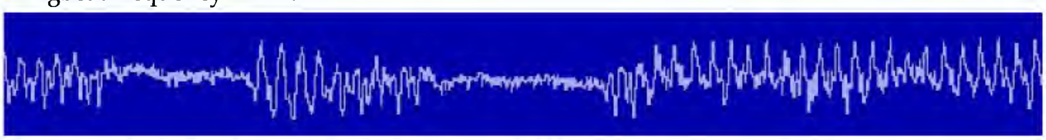

Figure 5. Typical pattern for swift-like birds with irregular wingbeat phases and pauses, wingbeat frequency 7.5 Hz.

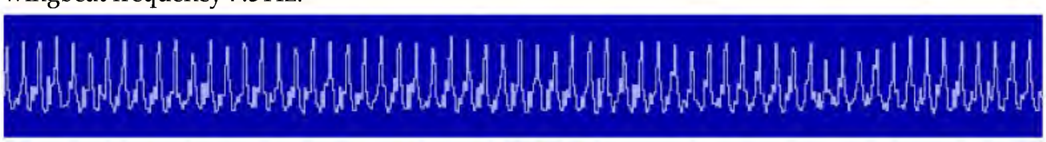

Figure 6. Typical wing beat pattern for wader-type birds with continuously-beating phases and a frequency of 8 Hz.

Twilight data set

For separating day and night, we used twilight data (civil sunset and civil sunrise, 6° below the horizon) derived from the R tool twilight (Lisovski & Hahn 2012). Because of the position of the radar station situated so close to the equator, there is no noticeable change in seasons throughout the six-month research period.

Results

Catching

In November and December 1969, when Ngulia Safari Lodge was opened, the area immediately in front (i.e., north) was illuminated during the night by several 1-kW and one 1.5-kW floodlights; the 1.5-kW light, sited high up on the building's wall, resulted in large numbers of birds and insects killing themselves (Pearson *et al.* 2014). This light was quickly removed in early December 1969 because of the carnage it caused (G.C. Backhurst, pers. comm.). From then onwards, for 50 years up until now, a ringing campaign has continued there, mainly during November and December. During some spring months, catching and ringing have been attempted. Since 1969, more than half a million Palaearctic birds have been ringed at Ngulia. Usually, the opening of the nets was decided by the weather conditions and by the number of ringing team members present. Misty weather conditions usually occur during the 20 or so days from the start of the ringing period, which are essential for catching. During the night, the nets were usually opened from 23:00 to 04:30 with three floodlights (3.5 kW in total) switched on; daytime nets were usually opened from 06:00 to 11:00. Nets were always under strict supervision and during nights when many birds were caught the ringers remained at the nets for as long as they were open. Often the nets had to be closed because of the large number of birds, and manpower constraints. During night time, the nets were open for a total of 2865 minutes or 47.75 hours (mean 3.2 h per night). For both day and night, 21 020 birds of 28 species were caught and ringed (Table. 1), of which 8564 individuals (41 %) were caught and ringed at night. The most-ringed species was the Marsh Warbler *Acrocephalus palustris* with 10 439 ringed, of which 4442 (43 %) were caught during the night and 5907 during the morning hours. During this ringing season, Thrush Nightingale *Luscinia luscinia* (5270 ringed), Common Whitethroat *Sylvia communis* (2330), and Barn Swallow *Hirundo rustica* (1541) followed the Marsh Warbler in numbers ringed.

Table 1. Numbers of birds ringed.

	Total night	Total day	Overall totals
Common Cuckoo *Cuculus canorus*	1		1
Eurasian Nightjar *Caprimulgus europaeus*	7		7
Eurasian Roller *Coracias garrulus*	3	1	4
Red-backed Shrike *Lanius collurio*	22	134	156
Isabelline Shrike *Lanius isabellinus*	10	23	33
Barn Swallow *Hirundo rustica*	1	1540	1541
House Martin *Delichron urbicum*		2	2
River Warbler *Locustella fluviatilis*	227	320	547
Basra Reed Warbler *Acrocephalus griseldis*	9	14	23
Great Reed Warbler *Acrocephalus arundinaceus*	3	2	5
Sedge Warbler *Acrocephalus schoenobaenus*	1	2	3
Eurasian Reed Warbler *Acrocephalus scirpaceus*		2	2
Marsh Warbler *Acrocephalus palustris*	4442	5907	10349
Olivaceous Warbler *Iduna pallida*	4	9	13
Upcher's Warbler *Hippolais languida*	9	24	33
Olive-tree Warbler *Hippolais olivetorum*	12	23	35
Willow Warbler *Phylloscopus trochilus*	103	89	192
Wood Warbler *Phylloscopus sibilatrix*		1	1
Blackcap *Syliva atricapilla*		3	3
Garden Warbler *Sylvia borin*	5	41	46
Barred Warbler *Sylvia nisoria*	7	37	44
Common Whitethroat *Sylvia communis*	812	1518	2330
Thrush Nightingale *Luscinia luscinia*	2719	2551	5270
Common Nightingale *Luscinia megarhynchos*	37	39	76
Irania *Irania gutturalis*	114	149	263
Rufous Bush Chat *Cercotrichas galactotes*	1	3	4
Common Rock Thrush *Monticola saxatilis*	2	6	8
Spotted Flycatcher *Muscicapa striata*	13	15	28
Red-backed x Isabelline Shrike *Lanius collurio* x *L. isabellinus*		1	1
Total	8564	12456	21020

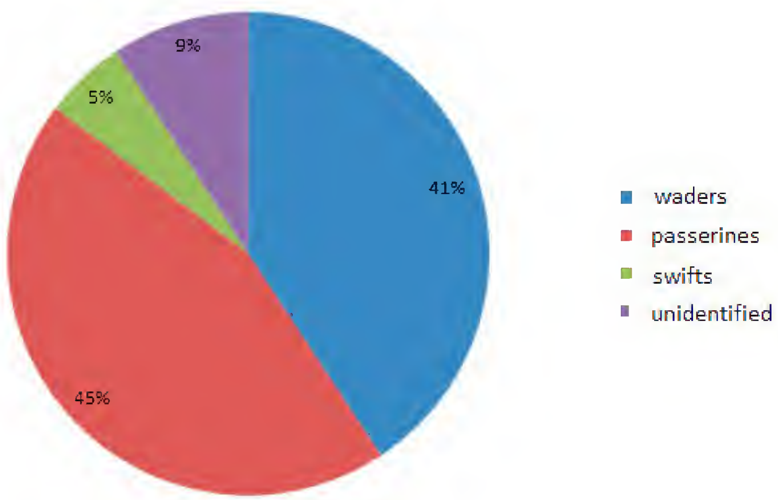

Figure 7. Distribution of all bird classes.

Composition of radar echoes

As shown in Fig. 7, the dominating classes of migrating birds over Tsavo West National Park were passerine (45%) and wader-like (41%) birds. Swift-like (5%), and unidentified birds (9%), played a minor role in the composition of migrating birds and are not presented in detail. In total, 3 million birds (extrapolated data) crossed a line of 1 km during the entire season (6 months, from November to April) over Ngulia Safari Lodge. Totals of 1.37 million passerine-like and 1.25 million wader-like birds were included in this passage.

General temporal distribution of bird migration

Figs. 8–13 show the general temporal distribution of bird migration intensities (MTRs) for all birds per month. Bird intensities increased in November from *c.* 500 to *c.* 2000 birds/km/h within the first ten days, after which there was a distinct decrease again (Fig. 7). After a technical failure of nine days, some nights towards the end of the month reached almost 3000 birds/km/h (Fig. 8).

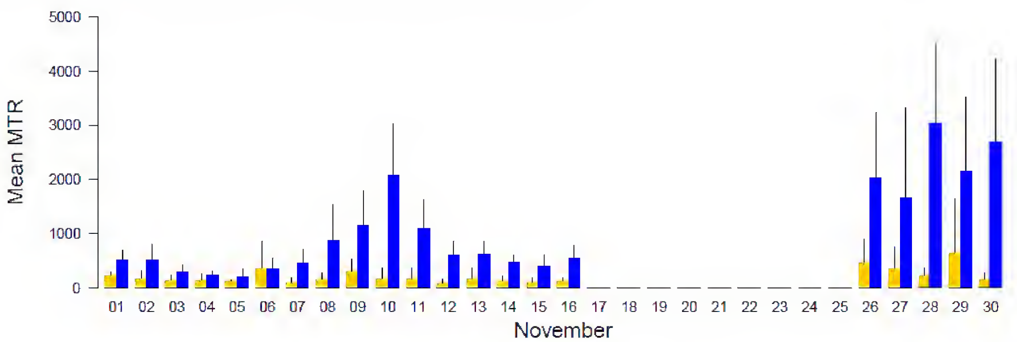

Figure 8. Seasonal phenology of MTR for all birds during November, separated by day and night (the missing data set from 17 November to 25 November was due to technical problems).

In December (Fig. 9), the MTRs rose steadily with the maximum peak on 5th (>3000 birds/km/h) and remaining at a high level (1500–2000 birds/km/h) throughout the month.

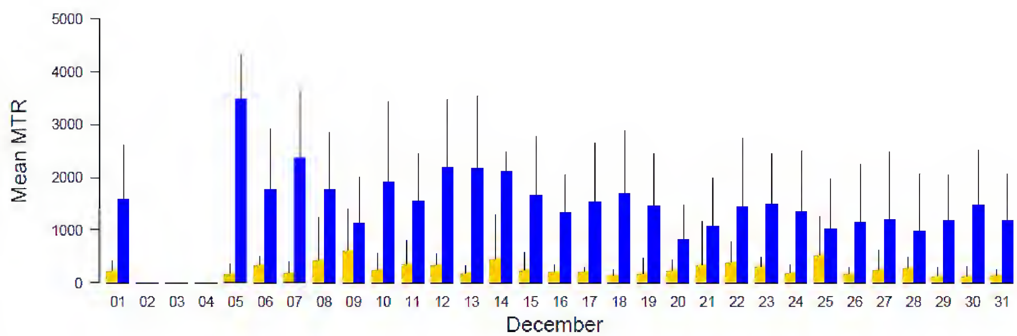

Figure 9. Seasonal phenology of MTR for all birds during December, separated by day and night (the missing data set from 2 December to 4 December was due to technical problems).

Migration in January (Fig. 10) was characterized by smooth fluctuations, often reaching over 1000 birds/km/h during the nights.

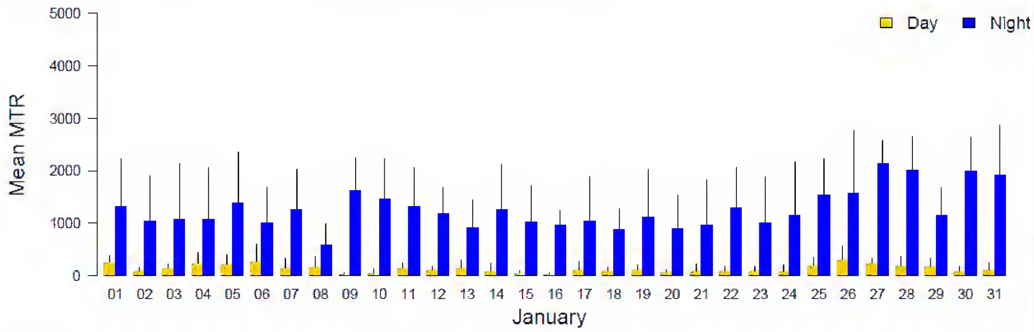

Figure 10. Seasonal phenology of MTR for all birds for January, separated by day and night.

In February (Fig. 11), the MTRs remained high up to 7th, after which they dropped rapidly to below 1000 birds/km/h, and they stayed at this lower level for the rest of the month (with the exception of 27 February 2014).

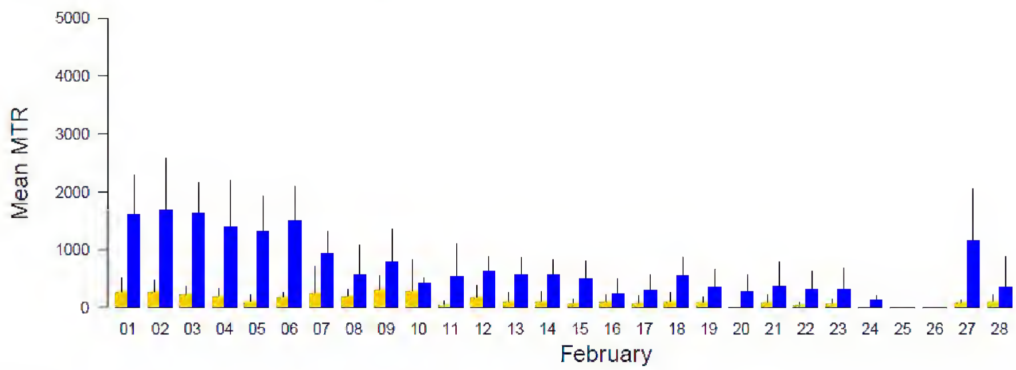

Figure 11. Seasonal phenology of MTR for all birds during February, separated by day and night (the missing data set from 2 February to 26 February is due to technical problems).

In March (Fig. 12), when northbound spring migration is expected, noticeable migration started after the first ten days with low MTRs throughout the month, reaching 1000 birds/km/h again in the last 10 days of March.

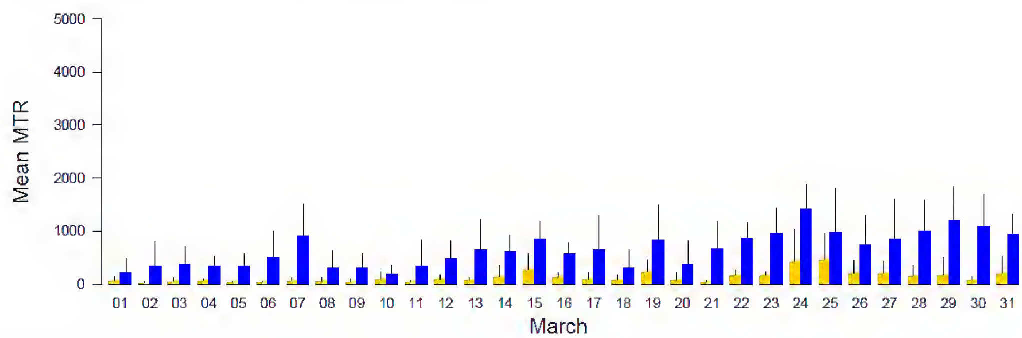

Figure 12. Seasonal phenology of MTR for all birds for March, separated by day and night.

In April (Fig. 13), the migration intensity (MTR) at Ngulia stayed continuously at a level above 1000 birds/km/h until the middle of the month. Afterwards, it dropped slightly to values of 500 birds/km/h.

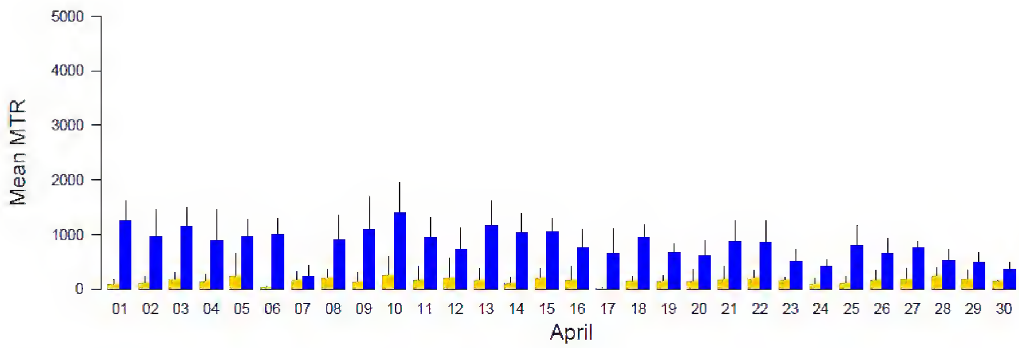

Figure 13. Seasonal phenology of MTR for all birds for April, separated by day and night.

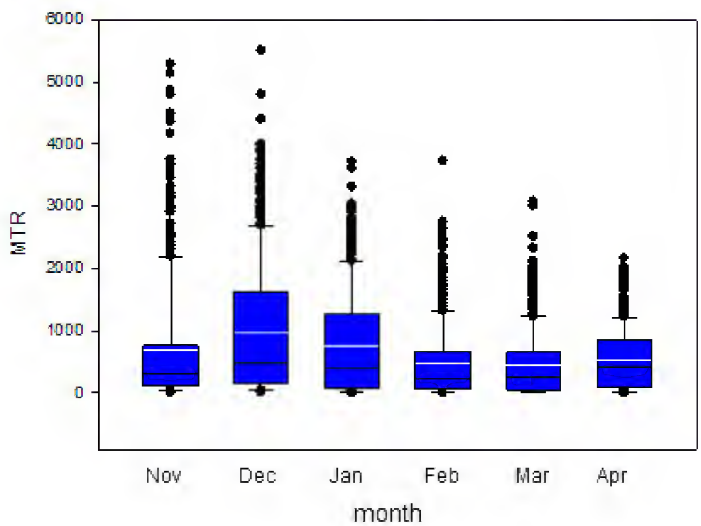

Figure 14. Mean MTRs per month for all birds, only nocturnal migration.

Monthly comparisons (Fig. 14) of MTR numbers for all birds appear to rise from November (mean = 702 birds/km/h) to December (mean = 974 birds/km/h), then decline in January (mean = 744 birds/km/h), but they still display high numbers. February and March show the lowest intensities with means of 482 birds/km/h and 441 birds/km/h respectively. In April, the values rise again (mean = 528 birds/km/h), but never reach the high numbers of November to January.

Migration in the course of the day

Throughout the season, passerine migration at Ngulia began two hours after sunset, at around 20:00 and continued at the same level until midnight whence it declined slightly into the morning hours, with a drop at sunrise around 06:00. This low rate remained until midday (Fig. 15).

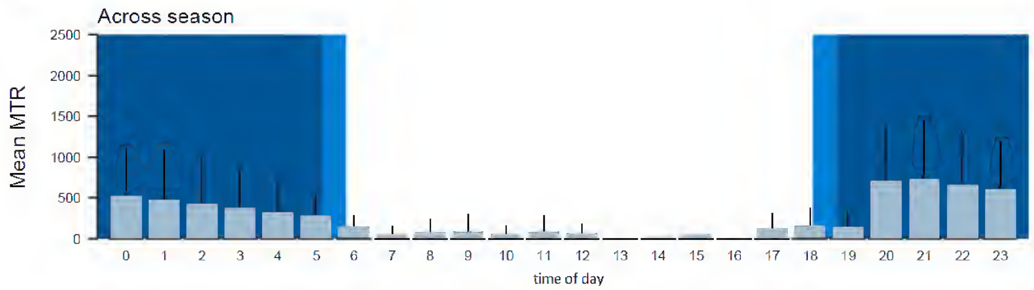

Figure 15. Mean MTRs per hour for passerines (light blue: sunset and sunrise, dark blue: night).

Catching and ringing numbers, and radar counts

Figure 16 shows the seasonal phenology of caught birds and bird intensities (MTRs, measured by radar) within the catching period. Unfortunately, there was a gap in radar data for five days because of technical problems. In general, the fluctuations in numbers of birds caught corresponded well with the radar counts, indicating that if many birds are in the air, many birds are caught. Finally, Fig. 17 shows the correlation of the numbers of birds caught with the MTRs for the opening hours (sum of MTRs from 23:00 to 08:00 next day). We found a strong correlation ($R^2 = 0.4094$, $p = 0.002$) with birds ringed and sums of MTRs.

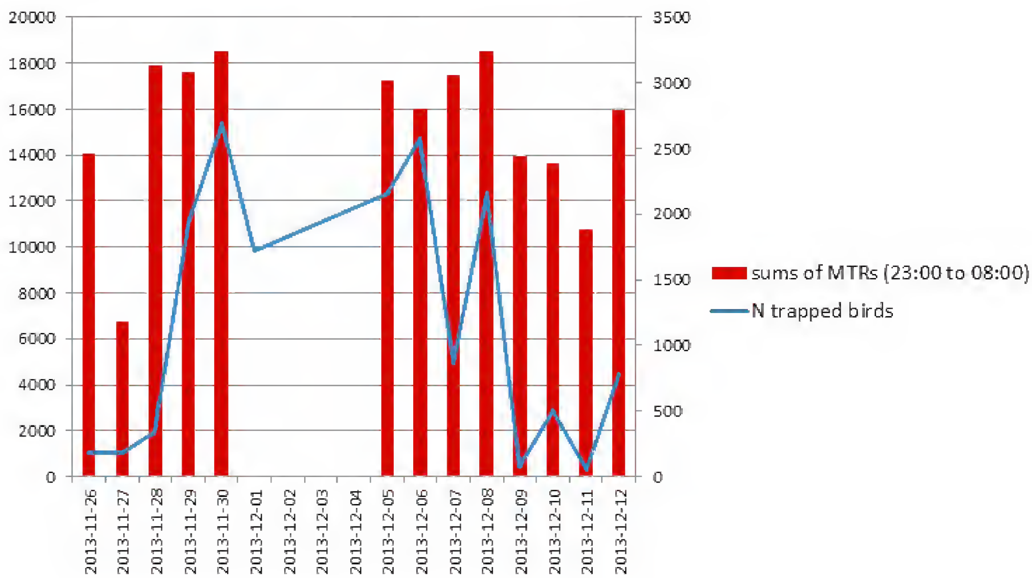

Figure 16. Comparison of MTRs (mean values from 23:00 to 08:00 next day) and catching, only for the period of catching (2 November–12 December).

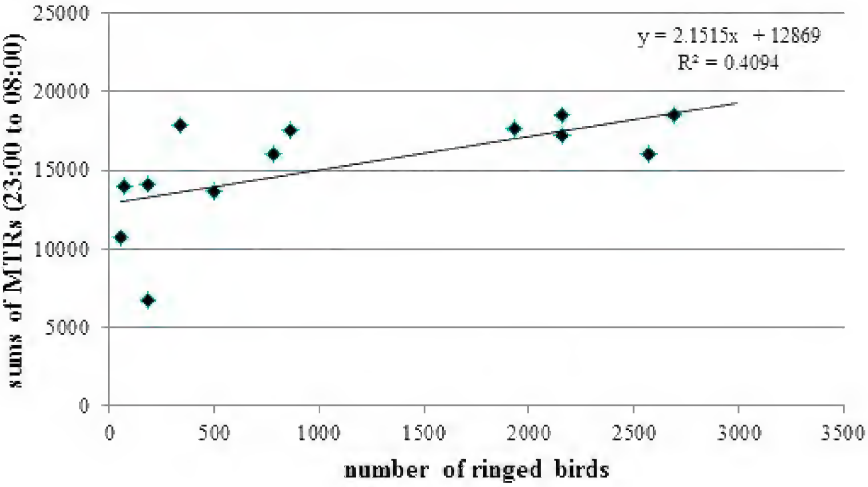

Figure 17. Correlation of caught birds and migration intensities (MTRs), sums per night (from 23:00 to 08:00 next day).

Spatial distribution

Bird migration below the horizontal view of the radar beam could not be measured with this radar system because technically, the radar beam can only be positioned to the horizontal view. Lower positions are not possible with this radar. This implies that a certain proportion of bird migration was missed, because birds flying below the escarpment were out of the detection range of the radar system.

As shown in Fig. 18, the majority (>50%) of the migrants used the lowest height ranges, up to 400 m a.g.l. (above ground level). The 5% margin was at around 1000 m a.g.l. Remembering that the radar station at Ngulia was positioned at 920 m above sea level, the majority of the radar-tracked birds were moving dominantly in height ranges of 950 m above sea level to 1300 m above sea level (a.s.l).

Comparing the spatial distribution by months (Fig. 18), in November, when migration intensity was increasing (Stark *et al.* in prep.), we found the highest proportion of migrating birds in the lowest height range (40%; 950–1150 m a.s.l). In December, with the highest MTRs, the passerine-like birds used a wider height range. Fifty percent used the height range from 950 m up to 1600 m a.s.l. In January and February, with a decreasing migration intensity, the height distribution was almost identical to that in December. In March, when northward migration is expected to start, the height distribution did not change, but in April, it showed a different pattern, with less migration in the lowest height range (0–200 m a.g.l) and a peak in the upper range from 200 to 400 m a.g.l (1100 m to 1300 m a.s.l).

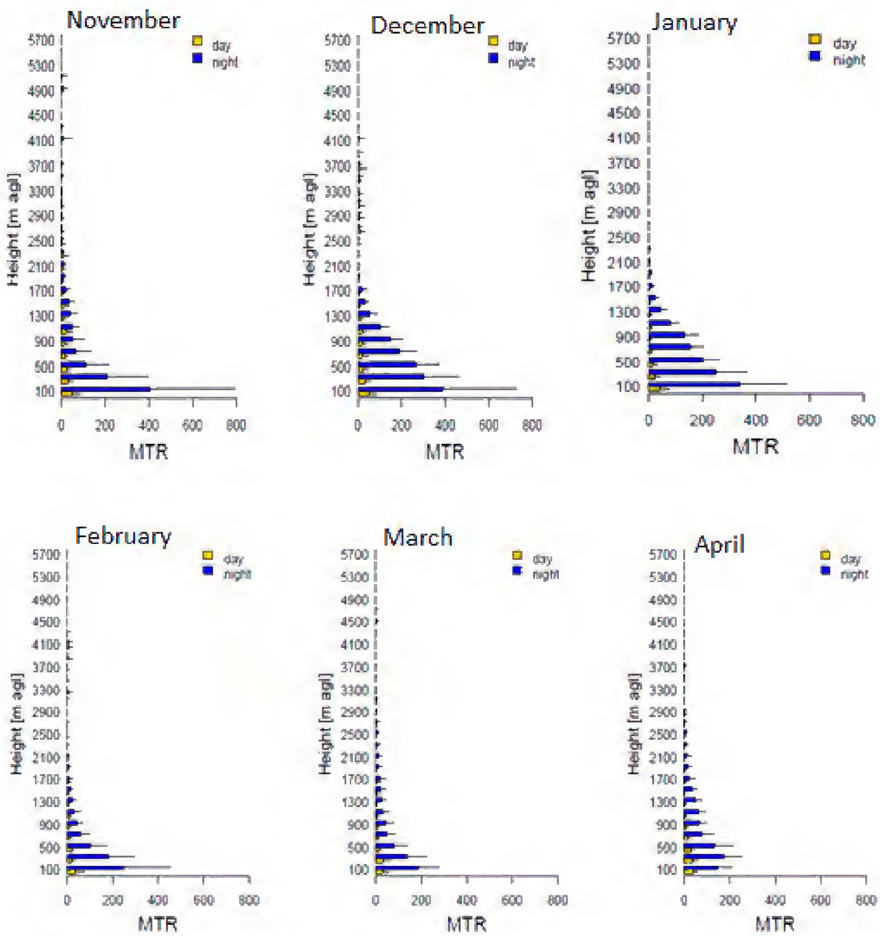

Figure 18. Monthly spatial distribution of MTRs for nocturnal passerine-like birds from November to April.

Flight directions

For the evaluation of flight directions, we used the data set when the beam was pointing to northeast (45°), expecting that changes in distances of a bird track passing the radar beam might provide an indication of flight direction. Assuming that the birds are flying southwards from November to January, and northwards from February to April, there should be noticeable changes in the course of the season. Figure 19 shows the principle of the evaluation of flight directions. In November/December, when a bird (coming from north) flies into the radar beam, the first distance when touching the beam should be higher than the second distance when the bird is leaving the beam. In this respect the subtraction of distance 1 from distance 2 should be positive, and the opposite when the birds are flying to the north. The subtraction of distance 1 from distance 2 should be negative. For this evaluation we only used longer tracks (staying in the beam for >2s). For passerine-like birds (Fig. 20), the higher proportion (71%) of negative values was seen in March and continued into April. The southbound migration was dominant during December with a proportion of 90%. Approximately 75% of these echoes showed a southbound direction, which was still

visible in February, but with a lower proportion. In March and April, more than 70% of the echoes were oriented to the north.

The southbound migration of passerine-like birds was dominant during November (80%) and December (90%). Approximately 75% of echoes in January showed a southerly direction, which was still visible in February, but at a lower proportion (55%). In March and April, more than 70% of these echoes were oriented to the north, demonstrating the northbound migration back to the breeding grounds in Eurasia.

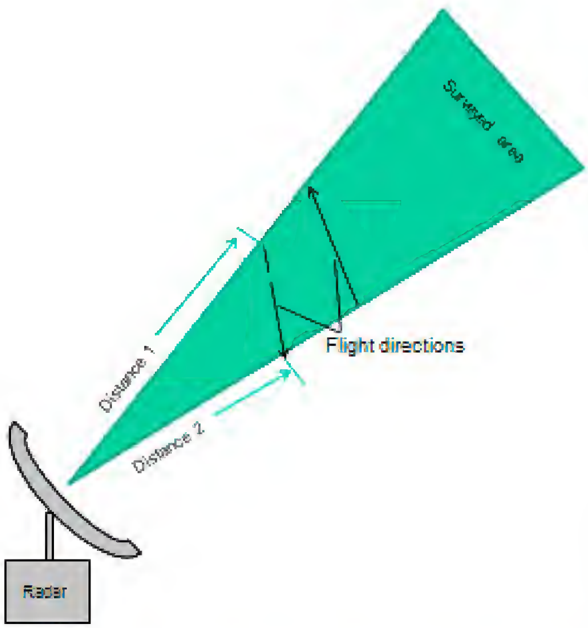

Figure 19. Principle of calculating flight directions with the radar beam pointed to the northeast (45°).

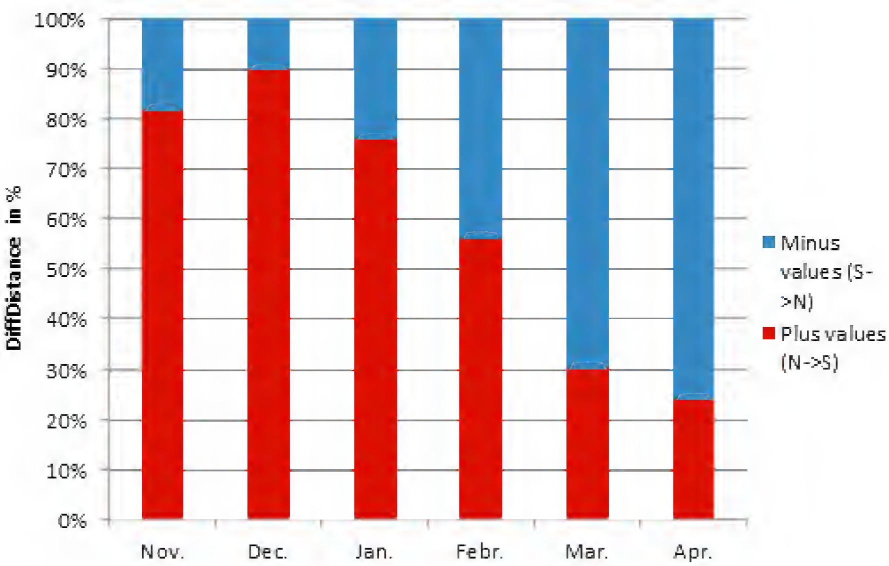

Figure 20. Distribution of negative and positive values for flight directions per month for passerine-like birds.

Wind and migration

The influence of wind speed and direction plays a major role in bird migration systems (Liechti *et al.* 1995). To understand the wind system close to the equator, we obtained a data set for wind direction and wind speed for different altitudes (from 850 mb = 1400 m a.s.l. up to 700 mb = 3000 m) with the RNCEP tool (Kemp *et al.* 2012). Direct meteorological measurements are not available in this region of Kenya. These data are extrapolated to show that, in the Tsavo highlands, mostly easterly winds dominate throughout the entire season. Figure 21 shows, for the lowest available altitude (850 mb corresponds to approximately 1400 m a.s.l) that wind directions during the night (midnight to 06:00) show a trend in the course of the season, from easterlies in November, and more northeasterly in December/January/February, shifting towards southeasterly from March to April. Wind speeds at the lowest altitude (850 mb) were moderate during the nights, ranging from 4.9 m/s (December and March) to 6.3 m/s (January), see Fig. 22.

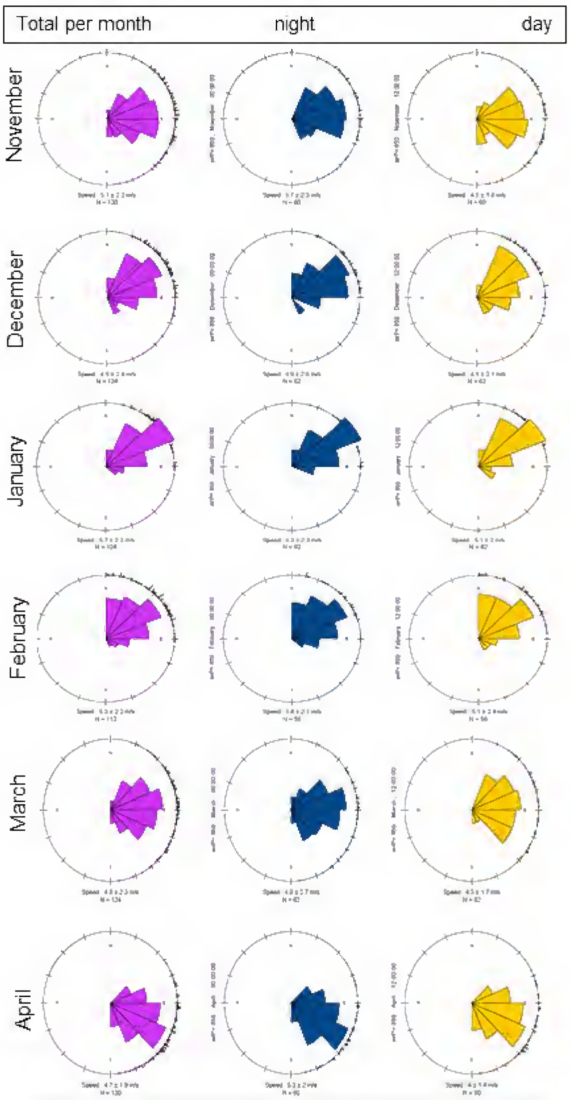

Figure 21. Wind directions and speeds per month for 850 mb (~1400 m a.s.l.) for the entire day (left column), for the night (column in the middle), and for daylight (right column).

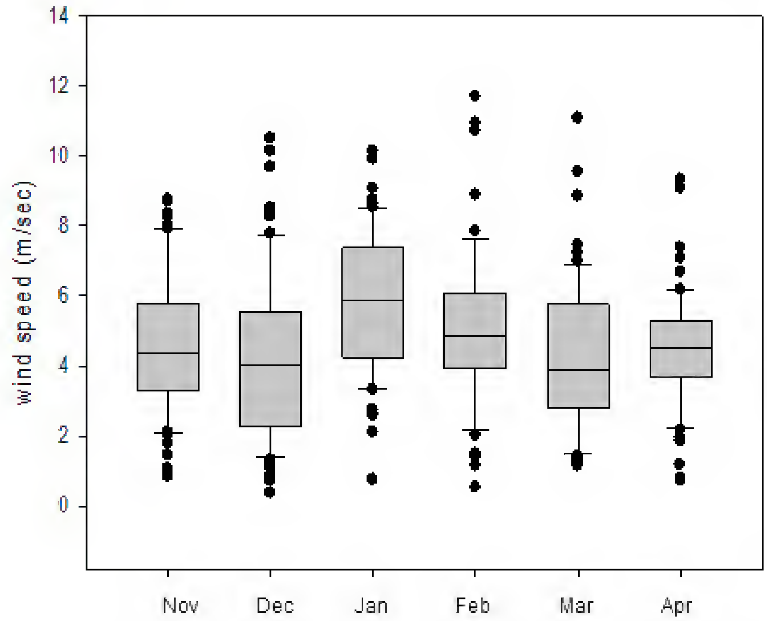

Figure 22. Nocturnal wind speeds per month at Ngulia Safari Lodge from November 2013 to April 2014.

Discussion

According to Pearson (1990), Palaearctic passerine species wintering in southern Africa originate from western Asian and Russian breeding areas, at 30° E to 80° E longitude, but a few European species, notably the Marsh Warbler and Thrush Nightingale, move southeast to join those from Asia in the Middle East. Eventually, all these birds then migrate together through eastern Africa, returning via a similar route in spring (Pearson 1990). Migrating birds reaching tropical Africa from the Palaearctic initially enter marginal savanna habitats that experience strong seasonal weather changes. These areas are relatively rich in resources during the June–September rainy season, but then become progressively desiccated (Moreau 1972). Thus, migrants tend to penetrate from the Sahel zone further south, where they find more suitable, humid conditions.

Migration intensity in the course of the season

Long-distance migrants from western Eurasia cross the Saharan or Arabian deserts to reach northern tropical areas. There they interrupt their migration for up to three months before resuming their flight to the south. During this stopover period, many birds undergo a partial or complete moult. It is known that these migrating birds, using the East African Flyway, stopover in Ethiopia for two to three months (Yohannes *et al.* 2007, 2009, 2013) to moult before continuing their southward migration in November when environmental conditions become unfavourable. This explains the peak of migration over eastern Kenya at the end of November and the beginning of December, when the migrants from northern parts of Africa also pass over, heading south. For the period from November to January, where we found pronounced southbound migration, in total 1.3 million birds crossed Ngulia Lodge over a line of 1 km,

heading south. From February to April, around 50% of the autumn number headed north (730 000 birds/km/h). The figure of 50% heading back to the Palaearctic is due to many factors. Migrants leave their wintering areas in southern Africa only a few weeks before arriving back in the Palaearctic. The return passage through Kenya and Uganda between late March and early May is thus more rapid than the southward movement. Only a few ringing attempts have been possible in spring at Ngulia. Pearson (1990) reports that in several Rift Valley lakes in Kenya, and at two sites near Nairobi, some 4000 birds were caught and ringed in spring between 1971 and 1984. However, on the few occasions when suitable conditions have been encountered in April, birds at Ngulia were grounded in hundreds or thousands, much as in November–December (Pearson 1980). The species composition was different from that in November–December (Pearson 2014). In contrast to these findings, the radar data show that approximately 50% of the southbound migrants either did not return to the north, because of mortality in the wintering grounds, or because they used other flyways in spring, such as the Red-backed Shrike *Lanius collurio* (Tottrup *et al.* 2012). Also, it was found that migrating birds in spring are fatter than in winter, implying that these birds do not need to stop so often (Pearson 1990).

Migration intensity in the course of the day

The intensity of bird migration in the course of the day shows a typical pattern, known from many places in Europe and northern Africa. Passerine birds usually rest for foraging during the day then start the next stage, mostly shortly after sunset, and increase steadily, with a peak at midnight, then slowly decline into the morning hours with fewer migrating birds after sunrise. During the morning hours, and until midday, there is no noticeable migration over Ngulia Safari Lodge.

Comparison of migration intensity in East Africa and Europe

Overhead migration intensities over Kenya and Europe do not fluctuate very much during the course of the season (Nilsson *et al.* 2018). The comparison of maximum intensities shows clearly, as expected, that in Europe, higher intensities are reached. Comparing Ngulia radar results with radar data derived in autumn 2013 in Austria, we find that the maximum values at the Austrian station (Würzberg, 48°04′N, 14°30′E) were three times higher than at Ngulia. This is explained mainly by the different species composition of the migration in Europe and at the equator. At the equator, only long-distance migrants appear to migrate further down to South Africa. Bird migration south of the equator is dominated by a small number of Palaearctic species. Forty-four passerine species commonly reach the equator and 21 of these extend their migrations further, to winter mainly, or in part, between 5° S and 25° S (Pearson *et al.* 1988). These migrations between the Palaearctic and southern Africa, typically 6000–10 000 km, include some of the longest passerine journeys known.

Migration south of the equator is best known in Kenya in central Nyanza, around Nairobi, and in Tsavo (Pearson & Backhurst 1976), and in Uganda, around Kampala (Pearson 1972). In the Ngulia hills in Tsavo National Park (West), southward-bound night migrants are attracted and grounded in mist, often in thousands at the floodlights of a game viewing lodge during moonless periods in November and December. Over 566 000 Palaearctic (mainly) passerines have been caught and ringed since 1969 (Pearson & Backhurst 1976, Backhurst & Pearson 1977, 1984, 1988, Pearson 2013, 2014, 2015, 2016a, b). Appearances of grounded birds are not, however, always a good reflection of the strength of migration overhead (Pearson 1990).

The present study shows that for nocturnal bird migration, a good relationship exists between migration traffic rates (measured with radar) and numbers of birds caught simultaneously in mist nets. A comparison with daylight migration was not possible, because, due to technical reasons, daylight measurements could only be done up to 12:00. After 12:00, the electricity generator at the lodge was switched off every day until 17:00 to conserve diesel fuel.

The radar data clearly show that the period for catching and ringing migrating birds at Ngulia Safari Lodge was very well chosen during the time of the highest migration traffic rates, as determined by radar. Catching occurred during the strongest movements of migrating birds. The catching success under various conditions is quite diverse. The few trials under suboptimal conditions had absolutely no success. Clearly, the presence of mist and small moon conditions is essential for catching success. Under swirling mist conditions for example, a maximum of 471 birds have been caught per hour—on 30 November 2013.

'Logically', this implies that under clear, mist-free weather conditions, no birds are migrating, which is of course not the case! The migration intensities derived from radar show that under clear conditions with good visibility, migration is certainly ongoing, but there were no efforts undertaken to attract birds with floodlights and sound luring, because, from long experience of trying this over many years (G.C. Backhurst, pers. comm.), birds will never be attracted down during clear weather conditions.

This strong relationship, radar : catching, is due to the fact that nocturnal migrants were caught during active migratory flight, when weather conditions were changing over Ngulia Safari Lodge. There are other reports of the grounding of migrating birds in eastern Africa caused by lights (Boothroyd 1987, Nikolaus 1980, Pearson 1981). Additionally, in this case, the attraction of strong lights on the ground plays a major role. It is well known from coastal lighthouses, oil drilling platforms, and ships (Bourne 1979), that birds are attracted to light under bad weather conditions, such as mist or fog (Ballasus *et al.* 2009). In recent times, it was noted that at offshore wind energy facilities (FINO 1, North Sea) birds are attracted to the obligatory safety lights when visibility conditions are poor; birds then collide with vertical structures, resulting in casualties (Aumüller *et al.* 2011, Hüppop *et al.* 2006). On alpine passes such as the Col de Bretolet (1800 m a.s.l.) in Switzerland, with negligible resting habitat, during misty conditions birds are also attracted in large numbers to floodlights (Komenda-Zehnder *et al.* 2010). The reason for this attraction to lights under misty conditions is not really understood.

Spatial distribution and wind conditions

The spatial distribution of MTRs for passerine-like birds does not show any differences from month to month. Usually, birds on migration use altitudes with favourable tailwinds (Bruderer & Liechti 1995), as in Israel, where trade and anti-trade winds prevail. The trade wind conditions in Israel promote migration below wind shear level (1200–2000 m a.s.l.) in autumn, and flights above this limit in spring. In contrast to Israel, at the equator, we find a wind regime driven by the Intertropical Convergence Zone (ITCZ). The ITCZ, known to sailors as the doldrums, is the area encircling the Earth near the equator, where the northeast and southeast trade winds converge. In the Northern Hemisphere, the trade winds move in a southwesterly direction from the northeast, while in the Southern Hemisphere, they move northwestwards from

the southeast. When the ITCZ is positioned north or south of the equator, these directions change, according to the Coriolis effect imparted by the Earth's rotation. For instance, when the ITCZ is situated north of the equator, the southeast trade wind changes to a southwest wind as it crosses the equator.

The stability in altitude distribution throughout the season is due to the wind regime, which at the altitude of Ngulia Safari Lodge (920 m a.s.l), changes from more northeasterly/easterly in November–January to more easterly/southeasterly winds in March and April. This change of wind direction from November to April supports migrating birds, so they are not forced to look for better wind conditions at higher altitudes. In line with many studies (Bruderer & Liechti 1995, Liechti 2006), we observed that migrants in Tsavo West National Park adjust their flight altitude to make optimal use of tailwinds along the predominant migratory direction.

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Notes on Black Crakes *Amaurornis flavirostra* 1: Breeding, plumages, and social structure

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Summary

Records from a family of Black Crakes on a small dam include 16 nestings between September 1985 and February 1995, with results from laying to disappearance of fledged young tabulated. Successionally downy hatchling, juvenile, immature, and adult plumages are described with timing. Unexpectedly, there appeared to be two alternate plumages—'grey' or 'sooty'—in the third immature stage, with a possibility of the latter having previously been mistaken as a 'non-breeding' adult dress. Need for further research to confirm is stressed. Moults from 'breeding' plumage directly into new 'breeding' plumage were observed, but no moult from a 'breeding' into a 'non-breeding' dress was seen. Juveniles and immatures helped care for the young of up to four subsequent clutches, the fluctuating family membership contained between one and seven age classes and a maximum of 12 individuals on two occasions.

Keywords Co-operative breeding, plumages

Introduction

These notes were made at a small dam (Fig. 1) created in 1985 in Nairobi's Langata suburb (E 36°44′ 25.5″, S 1°22′58.5″, 1720 m). Introduced plants were a 25 m² clump of the lily *Pontedaria cordata*, two stands of papyrus *Cyperus papyrus* totalling *c.* 50 m², a 50-m² clump of reed mace *Typha domingensis* and 15 m² of reeds *Phragmites communis*. Waterlilies *Nymphae nuchalis* grew in a discontinuous peripheral band that varied seasonally between one and four metres in width. The dam's twin purposes were scenic and for culturing tilapia *Oreochromis andersoni*. These records did not start as planned, methodical research, but from notes made as personal memoirs. Yet as they accumulated, we were urged by ornithologists who visited the dam to assemble and publish them because they contained original material, despite an unavoidable anecdotal element.

The first record of a Black Crake *Amourornis flavirostra* at the dam was in September 1988. Within three weeks, typical Black Crake 'singing' (Huxley & Wilkinson 1979) was heard, suggesting that more than one individual was present, but a second individual was not seen until October 1988. Although no deliberate attempt was made to tame the pair, their initial shyness gave way to habituation by daily human activity around the dam until, scavenging for fish-feed pellets, they became tame enough to take food from the hand, walk between, on our feet, or on us as we sat beside the water, eventually getting in the way when we were netting fish.

This selective close tolerance was exhibited only towards us, our gardener and our two dogs, but not in the same degree towards visitors. Strikingly, the appearance of a strange dog—even if it was a Jack Russel terrier as were ours—elicited loud alarm calls and a rush for cover. The lynch pin of our certitude that these records pertain to a single family derived from this founding pair was the degree of their habituation. It is improbable that a new immigrant would immediately exhibit the same selective tolerance and recognition of human individuals and two dogs. Almost as improbable was that the presence of a shy alien arriving at the dam would have escaped our notice. While colour banding would have greatly enhanced our recognition of individuals and might be essential with completely wild birds, we point out that recognizing individuals without such aids was illustrated by, among many, the late Leslie Brown's studies of raptors (e.g., Brown 1972). Such ability is routinely demonstrated by farmers dealing with massed domesticated animals.

Figure 1. The dam in Nairobi's Langata suburb where Black Crake observations were made.

Irregularly, between September 1988 and February 1996, notes were made of the crakes and their 46 descendants from >2400 observations (varying between 5 min to 6.8 h) over 2423 d. In this time, the crakes laid 16 clutches. From their extreme tameness and age-based plumages, we could relate individuals to their natal clutches, but not always separate siblings within a clutch. Size differences between the breeding adults were obvious when they were together, but not otherwise and we assumed the smaller of the two was the female, as noted by Urban *et al.* 1986.

With normal foraging augmented by access to fish pellets, food was available to them *ad lib.* Such nutritional abundance may be rare but not unknown in nature. Pitman (1929) described an islet in Lake Victoria "…which literally swarms with these Rails …Their nests are everywhere in the bushes." The superabundance of chironomid lake flies would have provided Pitman's crakes with similarly abundant food.

We use the term hatchling for the immediate post-hatching bird, juvenile for those in their first feathered stage, immature for those in the following plumage, and adult for those in full black plumages.

Nests

As recorded by Urban *et.al.* (*loc. cit.*) and others, the Black Crakes made two types of nest: one for resting and the other for breeding. The former were shallow-cupped platforms where they rested, preened, and slept. Several such nests were in use simultaneously, the most at any one time being eight. Such resting nests were built by juveniles, immatures and adults. Breeding nests were more substantial and deeply cupped (diameter ± 20 cm, depth of cup *c.* 10 cm). No juvenile birds were seen contributing nesting material to breeding nests. Both types of nests were placed in emergent vegetation over water.

The construction of two breeding nests observed from beginning to completed clutch laid, were made by the breeding pair helped by an 'extra' adult, and an immature in one case; and in the other, by the breeding pair and an immature. In both cases, all birds brought and placed nesting material on the structure, but the immature bird also passed material to an adult which then positioned it. Gravity kept the loose mass of plant parts in place. In the second nest, a first egg was laid when the cup was still shallow, but it had become much deeper by the time the fifth and last egg of that clutch was laid.

One breeding nest (Fig. 2) was analysed when no longer in use. It was in papyrus and made of only three materials: sections of *Typha* leaf, fronds from papyrus heads and bits of grass stem and leaf from *Panicum repens.* The dry mass weighed 250 g from which a sample of 45 g containing 169 plant parts was analysed. Extrapolated, the whole nest would have contained 939 items. Plant parts were identified to species in four length classes (<11 cm; 11–20 cm, 21–30 cm and >30 cm) as shown in Table 1. Structurally, papyrus fronds and grass contributed little to the nest, being mainly cup lining, with the bulk of the nest made from *Typha* leaf. All pieces >11 cm long were folded back on themselves, the longest being folded four times. All the nest materials had come from within the contiguous papyrus and *Typha* beds or from their edges.

Figure 2. A typical Black Crake nest with a clutch of five eggs located in a patch of papyrus.

Table 1. The contents of a Black Crake nest, with proportions of the plant species used and the length of plant parts (n = 169) in four classes.

Plant species	Proportion (%) of Plant Pieces in Length Classes				
	< 11 cm	11–20 cm	21–30 cm	> 30 cm	Total
Typha	38	9	2	3	52
Papyrus frond	21	10	4	5	40
Panicum repens	4	2	1	1	8
Total	63	21	7	9	100

One breeding nest and two resting platforms in *Pontederia* lilies were made from large fragments of that plant's stem and leaf, indicating that nesting material was selected from what was most closely available.

Clutches laid, hatched and hatchling survival in the first four weeks

Laying

Laying took place in the months of June, July, September, November, January, February, March, and May as noted in Table 2., and also in April 1995, after the study ended. The longest period between breeding attempts was 330 d, and the shortest 45 d, excluding *c.* 15 d (see below), the spacing between January, when a clutch was lost, followed by quick re-laying in February 1995, and the average time between clutches laid was 144 d (4.8 months).

Table 2. Number of breeding attempts, eggs laid, chicks hatched and survivourship in the first four weeks post-hatching. ? = eggs not seen but proof of hatching from seeing adults carrying food into cover or hatchlings emerged. 0 = egg or chick seen but disappeared.

Clutch #	Month	Eggs laid	End 1st week	End 2nd week	End 3rd week	End 4th week
c1	Jul 89	?	?	0	0	0
c2	Jun 90	?	2	0	0	0
c3	Jun 91	?	3	1	1	1
c4	Sep 91	?	3	3	3	3
c5	Jun 92	4	3	3	3	3
c6	Nov 92	?	3	1	1	1
c7	Feb 93	4	3	3	3	3
c8	May 93	3	3	3	3	3
c9	Sep 93	4	4	3	3	3
c10	Nov 93	?	?	4	2	2
c11	Mar 94	3	2	2	2	2
c12	May 94	5	4	4	4	4
c13	Sep 94	?	4	4	4	4
c14	Nov 94	4	4	4	4	4
c15	Jan 95	5	0	0	0	0
c16	Feb 95	5	4	4	study	ended

Sixteen clutches numbered c1–c16 were laid. Eggs of c1, c2, c3, c4, c6, c10 and c13 were not seen. No hatchling from c1 was seen, but its (their) presence was deduced from seeing both adults carrying insects into thick cover and subsequently finding a used breeding nest. In the other six nests where eggs were not seen, hatchling appearance could be used to set at least a minimum clutch size.

Both c8 and c12 were closely observed from first laying to hatching. Eggs in c8 were laid consecutively on 5, 6 and 7 May, partial incubation started on 8 May and was full time on 9 May. All three eggs were chipping on 26 May, 18 days after incubation started and all three chicks had hatched on 27 May. In c12, the first egg was laid on 10 May and the last on 14 May. Incubation began on 15 May. On 1 June, i.e. 16 days later, two chicks had hatched, and all were out of their shells by 4 June, hatching being attenuated over three days. Both these complete clutches thus hatched successfully.

Assuming eggs in clutches c5 (4), c7 (4), c9 (4), c11 (3), c14 (4), c15 (5), c16 (5) had suffered no loss when first seen and were complete, and including c8 and c12, the average clutch size was 4.1 eggs (n=9 clutches, 37 eggs). Of 37 eggs seen, 31 (83.8%) produced hatchlings that survived to the end of their first week. Other than the eggs of c15, which disappeared one night, it is not known whether the other five losses were as eggs or hatchlings. Table 3 summarizes losses of hatchlings from the end of their first week to the end of the fourth week. Hatchling ages were deduced from bill markings (see below).

Table 3. Hatchling survival between the first and fourth weeks.

	1st week	2nd week	3rd week	4th week
Number surviving	42	39	33	33
% as a proportion of preceding column	-	92.9	84.6	100

From 42 hatchlings seen, 33 were alive at the end of their fourth week—an overall loss of 21.4%. As hatchlings were unable to fly and unlikely to have left their natal dam at so early an age, we assume disappearances were due to mortality. Once able to fly in the juvenile stage, we were unable to ascribe disappearance from the dam to any cause.

Incubation and hatchling care

Crakes in both adult, or grey-breasted immature plumage, were seen incubating. In the short period between hatching and leaving the natal nest, a juvenile in brown plumage was once seen brooding newly hatched hatchlings.

Hatchlings were well coordinated and mobile within an hour of emerging from the egg. A hand placed within 30 cm of the nest of c14 to move a leaf to allow photography caused the adult 1 m away to give a gentle "kwep" sound. Two hatchlings clambered over the edge of the nest. The hand was withdrawn, the adult stopped calling and the two hatchlings returned into the nest bowl. This was the only case in which hatchlings were seen returning to a natal nest. Clutch c8 hatched on 27 May and hatchlings left the nest on 30th. In c12, hatchlings left the nest on the third day after the first egg hatched. In this case the last to hatch left the nest <24 h after hatching. Within 24 h of c14 starting to hatch, crakes in juvenile brown plumage had brought food to the nest, but passed it to the brooding bird, which then re-presented it to the hatchlings.

On 23 November, at 11:40 an immature brooding c14 was relieved by an adult which at 12:15 began calling a gentle "kwep". After a few calls it walked off the nest and stood a metre away, still calling—each call separated by one to several seconds. All four young suddenly clambered off the nest and followed the adult across floating rush leaves into dense *Panicum repen*s at the water's edge.

Food had been brought to the nest by all members of the family regardless of plumage, including sooty immatures.

New hatchlings initially stayed, not as a group, but separated in thick cover in the same general area as their nest. During this first week a hatchling usually had an older bird (juvenile, immature or adult) close by. After a week, hatchlings were left alone while all members of the family foraged. From this point on they wandered between clumps of taller vegetation around the dam's periphery, though initially spending very little time in the open intervening spaces. Rarely, they swam between these points across open water (Fig. 3).

Figure 3. A Black Crake chick four days off its natal nest crossing *c.* 15 m of open water between clumps of riparian cover, apparently of its own volition (photo: Jem Anderson).

Out of the nest, hatchlings were fed directly by all members of the family—juveniles, immatures and adults—who both brought food and brooded them. This was on a 'one-on-one' basis, a juvenile, immature or adult bird settling with a hatchling where it was.

Clutch c10 hatched only 45 d after c9 when juveniles from the latter still had downy tails and crown stripes and were themselves actively soliciting and receiving food from all older birds. Even so, these c9s fed the c10s both with items that they had foraged or solicited from a senior and which they then passed on to c9s. Thus, birds with some down in their plumage helped feed hatchlings of the next clutch, while still being fed by their elders.

The returning forager offered food by lowering its bill to the hatchling's level. The hatchling pecked at the bearer's bill and removed the offering. When more than one item was offered at once (up to three guppies *Poecilia* or meal worms *Tenebrio* sp. often being brought as a bill-load), releasing one might cause the others to drop. These were immediately picked up by the bringer and re-presented. As hatchlings grew, the bringer tended to drop items on the ground for the hatchling to pick up for itself. Hungry hatchlings solicited any approaching older bird by crouching—tail up, breast down, head and bill pointed upward—and waving their wings. In this, the wings were not moved in synchrony, but alternately in a rowing rather than flapping action. Once hatchlings were feathered, this 'alternate wing-rowing' was abandoned, but the begging bird still put the anterior point of the sternum almost on the ground and inclined neck, head and bill upward at an angle of around 45% from the horizontal. Supplicants adopting this posture did so from any angle, and even from behind, with the begging bird's head thrusting up from between its target's legs.

Hatchlings solicited adults for food into their 14th week although at a progressively declining frequency. A four-month-old c7 immature lost three toes to a catfish

(*Clarias gariepinus*) and, partially incapacitated, reverted to vigorously begging for food from all older birds. While none of the older crakes solicited presented food as they would to hatchlings, neither did any refuse to yield whatever they were carrying to the damaged bird. Despite its injuries, this individual still occasionally fed the newest hatchlings—either with food it had caught or begged from another.

Allo-preening was observed between the family's founding pair, between one of this pair (the larger = male?) and a downy black hatchling, between siblings in brown plumage and, on one occasion, in a communal session that involved the two founding parents, an immature in sooty plumage, a grey-breasted immature and a downy hatchling, all grooming one another.

Plumages

Hatchling – Downy Black

As described in all the references quoted above, hatchling crake plumage was black down, which in some light has an oily green sheen. At distances >1 m, iris, unfeathered tibia, tarsus and toes appeared equally black. In the hand, however, the iris was very dark brown. Black down unrelieved by obvious feathering persisted for *c.* 21 days. By day 28 the field impression was no longer of a wholly fluffy chick as dark feathers on head and body were growing out from the down. On some birds, the tips of remiges were just visible. The iris was now perceptibly very dark brown and legs dark slate.

A useful indicator of age was the changing dimensions of the crake's bill length relative to the overall size of its head. Relief in the hatchling's blackness was a short, bright pink bill. On emerging from the egg, this pink was interrupted by a thin dark mark across the maxilla just anterior to the nostril (Fig. 4). This grew larger, changing its position relative to the bird's bill as the latter grew. By days three and four post-hatching, the dark mark across the maxilla had widened to *c* 1 mm. At day seven and with bill growth, the mark had 'moved' further from the head and by day 14 it was a band around both mandibles as a 'shadow stripe' halfway along the bill (Fig. 5). By day 21 the dark band was perceptibly wider (Fig. 6). By day 28 the dark bill band had broadened asymmetrically making the central third of the bill blackish, the tip pale horn with some pink only visible on some parts of its basal third (Fig. 7). Throughout the first 28 days, the bill's initial bright pink had been fading in intensity. Indices of the changing relationship between bill length and the bird's head were derived from bill lengths divided by the distance between the anterior edge of eyes and the bill base.

These measurements were taken from photographs of individuals hatched from the same clutch and all were of the same age. Table 4. documents these indices which changed from 2.3 at hatching to 4.5 at 60 weeks as the bill grew progressively longer relative to the rest of the head.

Figure 4. Three hatchlings two days old.

Figure 5. The hatchlings' bill bands at day 14.

Figure 6. The bill band at *c.* 21 days old, remiges just appearing.

Figure 7. At *c.* 28 days, now no longer a downy hatchling.

Table 4. An index of bill length relative to the outline of the head, being culmen length divided by the distance between eye and base of bill.

Age in weeks	0	4	10	26	43	60
Bill index	2.3	2.8	3.5	3.9	4.2	4.5

Juvenile Plumage – Warm Brown

In the fifth week, head and breast were feathered dark brown from which all down had been lost and remiges were one-third grown. Some individuals retained their head down giving a fuzzy crown outline. The iris was still dark brown with legs and feet still dark slate. The maxilla was now dark horn—occasionally with a vestigial pale tip and the basal third very pale pinkish shading to dirty white.

By week six the field impression was of a warm umber brown crake with some vestigial down on the rectrice tips. Down retained on the head on either side of the central line, produced two distinct crown-edge stripes (Fig. 8), giving the impression of a double-Mohican human haircut. Remiges were half-grown, the iris more clearly brown and the legs slaty. The bill was now dark horn or black with a pale patch in the basal quarter of the maxilla that might still have had the merest suggestion of pink.

From week seven onward, all down had gone from the body except as vestigial fluff on the crown stripes, which were gone altogether by week eight. Remiges were three-quarter grown, reaching full length in week eight when the chicks could fly. The

pale patch on the basal maxilla had shrunk to little more than an outline around each nostril, and in some to a very thin line around the base of the bill, and the bird was now wholly brown (Fig. 9).

Figure 8. Among the last down to be lost is that on the head that stands up on either side of the centre line, as in the human Mohican haircut.

Figure 9. Bird at front in juvenile brown plumage.

Immature plumages – Grey-breasted or Sooty-black

Brown siblings from the same clutch became either grey-breasted or, at a distance, sooty-black, but close to, a very dark slate (hereafter 'sooty')—a phenomenon not hitherto reported. Moulting into either was gradual, though the onset is more readily apparent with the former because grey contrasts more with the juvenile umber brown than the dark sooty. Some emerging grey feathers were detectable as early as week eight (Fig. 10), but most birds were still predominantly brown until weeks 10 to 12. By week 14 moulting was sufficiently advanced for the grey morphs to be distinct from their sooty siblings of the same clutch (Fig. 11). Fig. 12 shows the sooty colour, in Fig. 11, wing-stretching, and illustrates the degree of blackness at this age.

Figure 10. Juvenile with hints of grey on cheeks.

Figure 11. The two immature plumages, grey-breasted left, sooty right, from the same clutch.

Figure 12. The bird on the right in Fig. 11 wing-stretching and emphasizing blackness.

Figure 13. A grey-breasted immature, for comparison with the (slightly younger) black morph in Fig. 12.

The most obvious change in the grey morph was a distinct paling on the sides of the head and, even more, the throat (Fig.13), which should be contrasted with Fig. 10, although the bird in the latter photo is slightly younger than that in Fig. 13. This progressed until with some, but not all birds, there were flecks of white on the throat. No wholly white throats, as described by Schmitt (1975) and Urban *et al.* (*loc. cit.*) from crakes in southern Africa, or even the heavier white 'splashes' on the throat of an Ethiopian specimen in the Nairobi National Museum, were observed.

Eventually the forehead, sides of head, throat, breast and belly were a grey that was the cleanest and palest on the sides of head and throat, but less clear on the breast. Shades of grey varied somewhat between individuals. Back, wings and tail feathers became olivaceous brown. In certain lights some birds imparted a false impression of faintly barred flanks and back (Fig. 14).

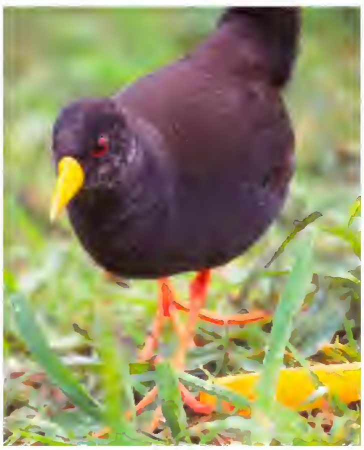

Figure 14. The same late grey morph bird in 4c displaying emerging black feathering on the side of head and how at certain angles the flank plumage can create a faint, but false, field impression of barring.

In the sooty morphs, the juvenile brown colour gave way to blackness or at close quarters a very dark charcoal grey on the throat, head, neck, breast, wing feathers and underparts. The 'blackness' was less intense than in adult plumages, but apparent from the middle and lower back, wings, tail coverts and the tail stayed brown.

Acquisition of the full immature grey plumage was not complete until week 24 (six months) and lasted until week 36 (nine months). At the onset of developing immature plumages—either grey or sooty—the irises were brown, there were no obvious eye rings and the exposed leg, foot and toes were still slaty or verging on a dark flesh brown. Bill colour was brownish-horn with vestigial pale areas about the nostrils, around the base or the basal third of the lower mandible. Between weeks 24 and 36 these pale bill areas expanded, replacing the brownish-horn through dirty greenish horn to bright greenish yellow similar to, but not as intense as, the adult Black Crake's. By week 36 (only four grey phases were seen beyond this

age) the irises were ruby-red, with orange to coral red fleshy eye rings and the exposed tibia, tarsi and toes were bright orange to coral red.

All immature sooties had disappeared from the dam before week 36, but not before some had acquired the iris, eye ring and foot colours seen in their grey-phase peers (Fig. 15).

Figure 15. Left, a 'breeding' plumage, right, a black morph immature about the same age as the grey morph in Figs. 13 & 14. Is this what may have been deemed an adult 'non-breeding' plumage?

Adult Black Plumage

As early as week 20, some grey morph immature crakes had a few black feathers changing into their grey plumage. This was more obvious by week 28 and apparent in four grey morphs by week 32. These black feathers were initially concentrated on the head, but also occurred elsewhere on the body. Their appearance was irregular and without symmetry between right and left sides. Thus, a black patch developed low on a left breast and another high on the same bird's right. Such patches expanded and coalesced. By week 36 the four grey-plumaged birds that stayed past this point rapidly become black and from a distance were difficult to differentiate from the two breeding adults. When together, their blackness seemed less intense.

Moults

We never saw either of the founding Black Crake pair switch between a non-breeding and breeding plumage—even when they only bred once in each of their first two years at the dam. Accepting that we may have missed the changes in subsequent years when they produced three then four clutches in a year, we never saw them other than in the same black plumage. Thus, we had no evidence of seasonal changes between putatively 'breeding' and 'non-breeding' plumages from these obviously breeding adults.

That is not to say we saw no evidence of moult while in adult plumages. In September 1992 the larger, presumed male, of the family's founding pair lost all remiges and rectrices simultaneously (as reported by Schmitt, *loc. cit.*). Two weeks later the smaller of the two followed suit. Both were flightless for not less than ten days, but possibly longer, and spent most of their time in dense cover. Both breeding birds underwent similar flightless moults a year later in the last week of September 1993.

In both cases of flightless moult, the birds appeared to go into it and came out of it in the same plumage. In November 1993, the individual of c5 that was recorded 'hiding' and keeping to cover, just prior to replacing one parent. The behaviour was similar to the earlier two moults observed and it may have also been moulting, but we could not confirm this. We had no evidence that remiges and rectrices were moulted simultaneously or that flightlessness occurred during the pre-adult plumage changes, and we assume these took place gradually.

Family dynamics over seven years

Other than for the original two adults, no other Black Crakes were recorded arriving on the dam between 1988 and 1995. As stated in the introduction, had any done so their behaviour is likely to have contrasted strongly with the residents' tolerance of people, and would have made them obvious.

In this study, out of 12 clutches, young of the preceding 11 (91.7%) helped their parents care for the next generation, while those from eight clutches (66.7%) helped look after two succeeding generations, and those from four (33.3%) helped with the following three, and some from three clutches (25%) helped with four successive sets. The average length of time that the offspring from 13 clutches (failures c1, c2 & c15 excluded) stayed with the breeding pair was 10.2 months (range 2–33). A single bird that stayed 33 months replaced the smaller (presumed female) of the founding pair after 17 months and for the remaining 16 months of the study, and mated with its parent, produced 12 clutches. Discarding that individual's record as anomalous, the average time young stayed as part of the breeding group was 8.2 months (range 2–15). Of the four birds that stayed on the dam into black plumage, two (one from c6 and one from c8) disappeared after about 1 month. One from c4 spent about two months while the fourth was present for three months, co-existing with its parents before replacing one of them. The first was fully black when it replaced a parent in the breeding pair. Table 5 tabulates the structure of the Black Crake family over time.

Table 5. Structure of the Black Crake family over time. Observations made over seven years are colour-coded to show the family structure based on their respective clutches. Hatchlings are grey, brown juveniles are brown/pink, immatures are blue, non-breeding adults are green, while breeding adults are yellow. X indicates c15's loss soon after laying. Also given are total individuals and generations present. All data are arbitrarily related to a monthly time scale.

Year	Month	Ads	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	c11	c12	c13	c14	c15	c16	All	Gen
1988	Sep	2																	2	1
1989	Jul	2	?																2	1
1990	Jun	2		2															4	2
1990	Jul	2																	2	1
1991	Jun	2			3														5	2
	Jul	2			1														3	2
	Aug	2			1														3	2
	Sep	2			1	3													6	3
	Oct	2			1	3													6	3
	Nov	2			1	3													6	3
	Dec	2			1	3													6	3
1992	Jan	2			1	3													6	3
	Feb	2			1	2													5	3
	Mar	2			1	1													5	3
	Apr	2				1													5	3
	May	2				1													4	2
	Jun	2				1	4												8	3
	Jul	2				1	3												7	2
	Aug	2				1	3												6	3
	Sep	2				1	3												6	3
	Oct	2				1	3												6	3
	Nov	2				1	3	3											8	3
	Dec	2				1	3	1											6	3
1993	Jan	2					1	1											4	3
	Feb	2					1	1	4										8	4
	Mar	2					1	1	3										7	4
	Apr	2					1	1	3										7	4
	May	2					1	1	3	3									10	4
	Jun	2					1	1	3	3									10	4
	Jul	2					1	1	1	2									7	4
	Aug	2					1	1	1	2									7	4
	Sep	2					1	1	1	2	4								11	6
	Oct	2					1	1	1	2	3								10	6
	Nov	1					1	1	1	2	2	4							12	7
	Dec	1					1	1	1	1	2	3							10	7
1994	Jan	1					1	1	1	1	2	3							10	7
	Feb	1					1			1	2	3							7	5
	Mar	1					1			1		3	3						8	5
	Apr	1					1			1		3	2						7	5
	Mam	1					1			1		3							5	4
	Jun	1					1			1				5					8	4
	Jul	1					1			1				4					7	4
	Aug	1					1							4					6	3
	Sep	1					1							4	4				10	4
	Oct	1					1							4	4				10	4
	Nov	1					1							1	4	4			11	5
	Dec	1					1								4	3			9	4
1995	Jan	1					1								4	3	X		9	4
	Feb	1					1								2	3		5	12	4

Comments

These observations add detail to earlier reports (e.g. Urban *et al. loc. cit.* and Hoyo *et al.* 1996) that a pair of Black Crakes can produce more than one clutch in a year. Juvenile and immature offspring remain with the breeding pair and assist with nesting, and the raising of subsequent generations. This contrasts with Schmitt (*loc. cit.*) who found the "young of the first brood are forced to leave their birth place as soon as a second breeding season starts." We suggest Schmitt's (*loc. cit.*) findings in the South African highveld of parents chasing young of a first clutch from their natal area with the onset of a second breeding, reflects flexible reproductive and social behaviour mediated by nutritional and climatic conditions.

With one exception, our notes on plumages differ in minor detail, but are in general agreement with descriptions by, for example Schmitt (*loc. cit.*), Urban *et al. loc. cit.*, Hoyo *et al. loc. cit.* and Taylor & van Perlo 1998. They all noted white throats on Phase 3 immatures, which we did not see, though they confirm Zimmerman *et al.*'s 1995 observation that this white may be absent or vestigial on some Kenyan birds as noted here. This feature is thus locally variable or a family idiosyncrasy.

The exception was our observation distinguishing two immature plumages in which a sooty alternative to the immature grey-breasted colour phase does not appear to have been reported before. Occurrence of dichromatism in immatures that is absent in adults seemed very improbable, but is illustrated photographically in Fig. 11. Behavioural differences between the two forms were slight: sooty morphs had left the family before week 36 whereas four grey-breasted morphs stayed on into adult plumage for varying periods. No sooty morph brought nesting material to a breeding nest—or incubated eggs—though they fed hatchlings.

It is possible that 'non-breeding' black dresses reported by others have, in fact, been immature sooties. We note that in the Los Angeles County Museum collection, Black Crake specimens 77053, 77054, 77055, 77056 and 77057 were all collected at a dam on the same Kenyan site between 12 and 16 February 1971. Similarly, in Pittsburg's Carnegie Museum of Natural History, their Black Crakes P139609, P139613 and P139700 were taken within two days in June 1960 from the east shore of Kenya's Lake Naivasha. In the light of our observations, collections from the same sites at the same time could represent a family with its succession of age classes in which greater or lesser intensity of blackness might reflect reproductive condition, but also be immature sooties. Because an alternative grey immature plumage was obvious, it might have predisposed field collectors to assume black plumage, *per se*, proved adulthood, and if dull, simply a non-breeding bird, as occurs with many species (e.g. Cattle Egret *Bubulcus ibis*), which have distinct breeding and non-breeding plumages. Further, unless examined carefully, an assumption of non-breeding condition would be bolstered by gonad states, small in both immatures and regressed breeding adults, being overlooked.

To check whether the difference between sooty and grey immatures was sexually determined, the sex of all grey-breasted Black Crake study skins was sought from the collections in Durban (12), Bulawayo (23), Nairobi (1) and the British Museum. Photographs of the Durban and Bulawayo specimens showed no specimens as grey breasted as that in Fig. 13. Specimens in the British Museum showed both female and male grey-breasted specimens (H. van Gouw, pers. comm.). The single Nairobi grey-breasted skin was a female. As pointed out by van Gouw, collectors may have made mistakes identifying gonads when preparing skins.

In South Africa, where temperate zone summer breeding and winter non-breeding seasons are well defined, avian reproductive behaviours tend to reflect this seasonality. Schmitt's (*loc. cit.*) and Taylor & van Perlo (*loc. cit.*) do report Black Crakes exhibiting two plumages—breeding and non-breeding. In tropical East Africa, annual seasons are less well defined than in South Africa. Brown & Britton (1980) recorded Black Crakes breeding in all months of the year in Uganda, their region B, and in all but one month in their region D, which included both equable Kenyan highland as well as the country's low arid north. In such circumstances, without a clear-cut non-breeding season, and some Black Crakes nesting in most months of the year, population changes between breeding and non-breeding plumages, would not be synchronous as in South Africa, and not easily detected.

In Uganda—Brown & Britton's Region B—their principal source was Pitman to whose findings we relate high crake densities with nutritional abundance (Pitman *loc. cit.*). In lacustrine Uganda, the climate is relatively warm and humid year-round. At the highland Kenyan dam that we describe, climate was equable year-round, and the crakes were also nutritionally affluent. Year-round breeding, both in our own and the Ugandan records, seems likely to be nutritionally driven and accounts for the pair of birds at the core of our observations nesting four times within a year. Despite annual moults, they did not display a non-breeding plumage, but changed back into a new 'breeding' dress.

We posit that astride the equator and in year-round equable climates with abundant nutrition, the Black Crakes can skip non-breeding plumages. More than one generation of helpers (six for four hatchlings on our dam in November 1993) may so free the breeding pair from tending young that they can breed faster.

The presence in the family of third adults of c4, c5, c6 and c8 (Table 3) raises the possibility of two birds laying in the same nest (Pitman *loc.* cit. suspected such an instance). The adult of c4 could have contributed to c6, but we discount it given the small clutch size (3). That of c5 could have contributed to c9, but although it went on to breed all clutches from c10 onward, we discount the likelihood given that c9 was only 4 eggs. If the adult of c8 was able to lay in its last month as an immature, it could have added to c12 whose five eggs varied in colouring, shapes, and sizes (in mm: 34.0 x 24.0; 32.5 x 24.0; 32.5 x 24.0; 30.0 x 23.0 and 30.0 x 23.0).The first of these eggs was truly oval, the second and third were conventionally ovoid, being broader toward one end, the last pair were more spherical than ovoid. All had creamy backgrounds, finely and densely flecked with grey, reddish and mauve. The first three had, in addition, a few larger irregular red brown freckles that the last round pair did not have. These differences are, at best, only inconclusive hints that two birds may have laid, as is c12's attenuated hatching period.

Given our very small data set, we draw no conclusions and are still puzzled by the apparent two phases of immature plumage. Yet incomplete as our data may be, they invite further research into the questions that have arisen. Given their small size, catholic diet, social flexibility and ease of habituation, the Black Crake may be a prime candidate for aviary research.

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Notes on Black Crakes *Amaurornis flavirostra* 2: Vocalizations, feeding and interactions with other species

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Summary

Black Crake vocalizations are described and compared to previous published records, as are observations of dietary items and interactions with other birds in the same habitat. An instance of site fidelity in extreme circumstances is given, together with an appendix of potential Black Crake predators sharing the same environment.

Keywords calls, diet, inter-specific behaviour, site fidelity

Introduction

The following miscellaneous notes on Black Crakes were recorded at the dam described in Parker & Parker 2019 as additions of detail and comment to what is already known about this species.

Vocalizations

Various calls were noted:

(i) Hatchling soft mews: either uttered singly or strung together; initially very softly, becoming louder as the bird grew, and enabled tending members of the family to locate the caller.

(ii) Hatchling 'lost' call: a louder, plaintive, extended mew given at two or three second intervals and often for several minutes at a time, uttered by an isolated hatchling.

(iii) Crakes with food approaching hatchlings, gave a low, fast, guttural "grr-grr-grr-grr", only audible to humans within 5 m.

(iv) Adults, sub-adults, immatures, and juveniles all give a gentle "kwep" of variable volume when minding hatchlings, in the vicinity of hatchlings on the close approach of people, dogs, mongooses, etc., entering the nesting vegetation. Incubating birds uttered it on several occasions before getting off their nest, and by adults apparently inducing hatchlings to leave the natal nest. Though not loud, it could be heard by humans at distances of up to at least 20 m. Overall, we associated it with alertness and low to medium levels of tension.

(v) Alarm, at the sudden appearance of a raptor, strange dogs, and danger: was a very loud and explosive "pew", accompanied by a rush for cover from whence it continued calling.

(vi) Black Crake 'singing' (if the components are not antiphonal, see Huxley & Wilkinson 1979) often indicates their presence before the birds are seen. It has been transcribed variously thus:

Mackworth-Praed & Grant (1952), "A shrill craking 'rr-rr-rr' which ends in a resonant croak"

Smitt (1975), "rrü–rrü–rrü."

Taylor & van Perlo (1998), one bird "a harsh repeated chatter 'krrok–krraaa', the other, a softer almost dove-like purring or crooning call which may comprise single notes 'crrooo' or a phrase such as 'coo-crr-ooo."

Urban *et al.* (1986), "Bird 1 'krrrok-krraaaa-krrrok-krrraaa.', Bird 2 ' krrooo-krrooo'

Zimmerman *et al.* (1996), "A throaty 'coo-crr-chrooo' and a rippling 'weet, eet, eet, eet, eet."

Such variation of a call all recognized in the field aurally, infers the recorders' different aural acuities, senses of musicality and linguistic ability to transcribe sound to paper. Consequently, we have reservations, including our own, about committing bird sound to writing down.

Black Crake calling was described as a 'duet' (in which contributions are antiphonal) by Urban *et al.* (*loc. cit.*) and Taylor & van Perlo (*loc. cit.*). Yet the term was inappropriate if it was performed occasionally by trios, quartets or even quintets, as Taylor & van Perlo's (*loc. cit.*) and our own observations of families singing together indicated. In such cases, birds of different ages all congregated within <1 m^2 that made it difficult to recognize which individuals were singing. This was even more so as Taylor & van Perlo (*loc. cit.*) found the song's dual components could be uttered by adults of either sex as well as by juveniles and immatures.

On all but one occasion duetting/singing was only heard from within the family's favourite patch of *Typha* or contiguous *Papyrus*, the two places where all but two breeding nests occurred (the exceptions were in *Pontedaria*, before the *Typha* and *Papyrus* were established). We never saw it performed without at least one adult taking part. Usually, but not always, both adults of the family were present. It was commonly given when an adult flew in to join others in the *Typha*. However, on one occasion an adult of the breeding pair, and a grey-breasted immature, performed the song without others present when the latter had just left the nest after a stint of incubating. It often followed sudden disturbances and also (but not invariably), when birds changed incubation shifts. It seemed an obligatory response to a tape recording of Black Crake calls recorded elsewhere and played within the family's hearing.

We heard calling at all times of the year, subjectively seeming more frequent just before and during egg-laying and incubation. In South Africa, Schmitt (*loc. cit.*) noted that it was seasonal and not uttered in winter between April and August. No such silent period was observed in the family reported upon in keeping with the year-round breeding in Kenya and seasonal breeding in South Africa (Parker & Parker *op. cit.*).

The calling seems to have two components: spaced musical 'growl notes' with higher 'trill notes' placed between the growls. We believe when one bird growls, another trills in response. Yet, subjectively, when there were more than two crakes present in a 'singing party', we could not tell whether only a pair or more members of it were calling.

In the same vein, we were unable to resolve whether such Black Crake calling is always antiphonal, one component following the other, or with some overlap between the two components. We suggest that when only two birds call, it is antiphonal, but that when more are involved this precision is lost and there is overlap.

(vii) On the day before it disappeared from the family, a crake in late grey-breasted

immature dress that lost toes to a catfish *Clarius gariepinus* (see Parker & Parker 2019), gave a series of squeaks while crouching and fluttering its wings when approached by any other crake, juveniles, immatures or adults, but not downy young.

(vii) Inside the *Typha* bed the founding female crake was seen with plumage fluffed out, wings akimbo and head down like a defensive domestic hen with chicks, pecking repeatedly at an agitated, metre-long, cobra's tail *Naja nigricollis*. The accompanying sound was similar to that made by a defensive hen, though 'in miniature'.

Feeding

Black Crakes' diet is widely described in the literature, e.g. Urban *et al.* (*loc. cit.*), and can be summed as most forms of animal life that it can subdue, but principally arthropods and a wide range of plant parts. We witnessed scavenging on a dead 6-kg catfish as well as other smaller fishes. So wide was this omnivorous habit, that it is easier to list items rejected. These included bees (which were abundant, drinking at the water's edge, but never seen taken), water scorpions *Nepa* sp., tadpoles of toads *Bufo* sp. and the aquatic clawed toads *Xenopus* sp. With the last two, inexperienced birds seized them, but dropped them and vigorously wiped their bills. In contrast, frogs, tadpoles and adults (*Rana* and *Pixicephalus*), were taken readily. Tadpoles, and small fish *Poecelia* and *Oreochromis*, were usually taken in water <3 cm deep, but several lunges to the length of the neck were observed to catch small tilapia damaged by netting. On a single occasion an adult crake dived to 40 cm to retrieve a handful of *Tenebrio* larvae thrown in for a Little Grebe *Tachybaptus ruficollis*. It had to bring one to the surface before swallowing.

The crakes showed specialized searching for tiny water-lily *Nymphaea nuchalis* seeds. When the plant's flower dies, its attached seed capsule sinks to develop under water. When ripe, the sunken capsule's casing rots, releasing seeds that, encased in an aril, float back to the surface. Many become trapped under the rafts of lily pads typical of *N. nuchalis*. Anything slightly submerging a leaf, as under a crake's weight, allows seeds to float round its edge on to the leaf surface to become stranded when the crake's weight is removed. The birds then gleaned them from on top of the leaves. Walking back and forth over lily beds, crakes searched for leaves above a rotting seed capsule-discharging seeds. Concentrating around such a site, their movements alternately submerging and letting the leaves resurface, produced a harvest of seeds. On Lake Naivasha, other rallids (Purple Swamphen *Porphyrio porphyrio*, Common Moorhen *Gallinula chloropus* and Red-knobbed Coots *Fulica cristata*) were also observed eating water lily seeds, but by opening the unripe capsules before they sank and the seeds were still clumped. They did not pick up individual seeds as Black Crakes did. Presumably the Black Crakes' smaller size makes their strategy economical, which might not be the case with larger species.

In 2005, Black Crakes feeding on moribund frogs *Rana*, *Pixicephalus*, and clawed toads (the toads uncharacteristically out of water) around the dam, drew attention to an outbreak of the chytrid fungal disease *Batrachochytrium dendrobatidis* that was causing conservation concern on other continents. Identified in tissue samples sent to Australia, this was among the earliest, if not the first, instance recorded in Africa (L. Berger, pers. comm.).

Interactions with other species

Reaction to animals other than prey varied. In dense cover, Black Crakes were bold and confiding. Even before habituated to people in the open, they approached to within a metre of a person or mammal inside the *Typha* patch. Any large bird suddenly appearing <20 m overhead elicited alarm calls and diving for cover. Some raptors (e.g., Black Kite *Milvus migrans* and African Harrier Hawk *Polyboroides typus*) elicited no alarm if higher than 20 m. The Accipitrines, African Goshawk *Accipiter tachiro*, Great Sparrowhawk *A. melanoleucus*, Shrika *A. badius*, and Little Sparrowhawk *A. minullus* all caused alarm regardless of distance.

No crake was seen within *c.* 5 m of any heron (Grey *Ardea cinerea*, Black-headed *A. melanocephala*, Purple *A. pupurea*, or Squacco *Ardeola ralloides*), but tolerated Hamerkops *Scopus umbretta*, Egyptian Goose *Alopochen aegyptiaca*, and domestic ducks, within 1 m.

Tolerance of smaller birds was illustrated when four weaver species, Grosbeak *Amblyospiza albifrons* (10 nests), Holub's Golden *Ploceus xanthops* (4 nests), Baglafecht *P. baglafecht* (2 nests) and Spectacled *P. ocularis* (1 nest), a Tawny-flanked Prinia *Prinia subflava* and a Black-faced Waxbill *Estrilda erythronotus* were nesting simultaneously within 5 m of incubating crakes. Individual adult Grosbeak Weavers were observed within a metre of an incubating crake, and one Spectacled Weaver collected nest fibre within 50 cm of it, the crake not reacting in either case.

On 30 March 1994 a mongoose *Herpestes sanguineus* entered the *Typha* bed where there were two downy crake chicks. The five fledged members of the family present gathered round it at distances of 0.75 to 1.5 m, all giving the low volume alarm or tension call—a relatively gentle, single note—'kwep'. The crakes kept up with the mongoose as it moved and while they went no closer than *c.* 0.75 m, in the face of this escorting behaviour the predator did not forage, but moved quickly away from the dam.

On two occasions a Black Crake seized a newly fledged Grosbeak Weaver that had emerged from a nest in the crakes' favoured clump of reed mace, and killed it by a combination of pecking, harassing and eventual drowning. It was not clear if these attacks were a feeding behaviour or an interspecific interaction whose outcome was secondarily food.

Predators capable of taking Black Crakes or eggs seen in the vicinity of the dam during the period covered by these notes are listed in Appendix 1.

Site fidelity

In January 1997, the dam dried out completely through lack of rain run-off and all the riparian vegetation was lost. The process was gradual with the family dwindling until only two adults were left. The last cover to go was a stand of papyrus. Before it was completely gone a loose tangle of dead brush (approximately 1 x 1 x 1 m in dimensions), mainly small branches measuring between 0.75 and 1 m long and not more than 2.5 cm thick, was put next to the papyrus as substitute cover. Before the dam was completely dry, we placed an enamel basin of 0.75 m diameter next to this brush, filled it daily with water and supplied commercial poultry pellets as feed. The crakes stayed but spent much time in the fringing woodland thicket of *Euclea divinorum* and *Eleodendrum buchananii* (see Fig. 1, Parker & Parker 2019). Despite being free to depart, as the rest of the family presumably had, these two adult Black Crakes adopted a pile

of dry wood, a tin basin of water and feed in lieu of their normal habitat, and stayed thus until the dam refilled in April, and riparian vegetation was replanted. They laid a clutch of four eggs in November 1997 and once again a family of Black Crakes occupied the dam and was present until at least 2011, when we left Kenya. The dam drying resulted in an unusual demonstration of site fidelity.

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Appendix 1

Between 1967 and 2010 predators capable of taking a Black Crake or its eggs recorded on the Langata property cited in Parker & Parker 2019.

Birds

Herons

Grey *Ardea cinerea*, Black-necked *A. melanocephala*, Purple *A. pupurea*, Black-crowned Night *Nycticorax nycticorax.*

Raptors

African Harrier Hawk *Polyboroides typus*, African Fish Eagle *Haliaeetus vocifer*, Common Buzzard *Buteo b. vulpinus*, African Goshawk *Accipiter tachiro*, Great Sparrowhawk *A. melanoleucus*, Shrika *A. badius*, Little Sparrowhawk *A. minullus*, Black Kite *Milvus migrans.*

Owls

Barn *Tyto alba*, Spotted Eagle *Bubo africanus* and African Wood *Strix woodfordii.*

Coucals

White-browed *Centropus superciliosus*

Mammals

Domestic dogs *Canis familiaris*, cats *Felis sylvestris*, genets *Geneta tigrina*, mongooses *Herpestes sanguineus.*

Reptiles

Snakes

An immature python *Python sebae*, cobras *Naja nigricollis*, and egg-eaters *Dasypeltis scabra.*

Turtle

Helmeted terrapin *Pelomedusa subrufa.* As a predator on waterside birds, this terrapin may be significant (Spawls *et al.* 2002). On the dam mentioned in this paper, 11 newly hatched ducklings were reduced to five between 08:00 and 13:00 one day, all only partially consumed.

Fishes

Largemouth Bass *Micropterus salmoides*, Sharp-toothed Catfish *Clarias gariepinus.* The former could take swimming hatchlings and the latter was observed on one occasion at the dam seizing a crake by the foot, and on another lunging at drinking weavers (D. Richardson, pers. comm.). The same species of catfish caught on Kenya's southern Uaso Nyiro River had seven *Quelea* sp. in its stomach (A. Archer, pers. comm.).

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Current status of diurnal breeding raptors in the greater Athi-Kaputiei Ecosystem, southern Kenya: an assessment of abundance, distribution and key areas in need of conservation

Sidney Shema

Summary

I document the current abundance and distribution of breeding and resident raptors in the greater Athi-Kaputiei Ecosystem of southern Kenya. Data were drawn primarily from field surveys and supplemented with secondary data from other observers' records, and open-source databases. A total of 138 nests were recorded, of which 103 belonged to globally threatened and near threatened species. A total of 135 resident pairs of raptors were recorded in the area, belonging to 20 species. An additional 26 non-resident raptor species were observed in the area with varying levels of frequency. Results indicate key areas that need to be prioritized for conservation as major development projects — including a standard gauge railway, wind energy facilities, and an expressway — are implemented in the wildlife-rich Athi-Kaputiei area.

Keywords raptors, Athi Plains, Nairobi National Park, sustainable development, human-wildlife co-existence

Introduction

Kenya is currently undergoing rapid industrialization as part of the country's Vision 2030 development agenda. Despite southern Kenya supporting populations of several threatened raptors (Sorley & Andersen 1994), there is a deficiency of data on the current status of these species in key areas. Key areas are mainly those supporting breeding pairs of threatened or near threatened raptors, as well as those that support prey populations, and hence serve as important feeding areas.

Sergio *et al.* (2008) suggest that studying the entire top predator assemblage (e.g., the raptor guild) of an area, rather than just a single species, can give a reliable indication of its prey species richness and overall biodiversity because of the low species-redundancy of predator communities. This, by extension, can help indicate an area's conservation value. In addition, focusing on resident raptors can be more important than assessing all raptor species as some occurrence records may be based on one-off observations of individuals that were just passing through an area and do not necessarily indicate high quality habitat (Thomsett 2015).

This study focused on the raptor guild of the Athi-Kaputiei Ecosystem, a 2450 km^2 area of savanna south of Nairobi that supports a diverse wildlife community, but that is currently developing and changing very rapidly, with negative impacts on wildlife

populations (Gichohi 1996, Ogutu *et al.* 2013, Ogutu *et al.* 2014, Said *et al.* 2016). Large-scale developments currently in progress include wind energy facilities, a Standard Gauge Railway, cement factories, and a major expressway. I document the abundance and distribution of resident raptors to identify key areas where conservation efforts should be focused as development progresses.

Methods

Study area

The Athi-Kaputiei Ecosystem, or Athi Plains, comprises a gently rolling savanna landscape (measuring approximately 2450 km^2) bounded by Nairobi to the north, the eastern wall of the Rift Valley to the west, a series of hills (Lukenya, Maua, and Mwambi) in Machakos to the east, and the rugged broken landscape of the Olkejuado Valley to the south (Fig. 1). The altitude gradually drops from *c.* 2000 m near Corner Baridi in the west/northwest to about 1600 m at Emarti in the southeast. The area's wildlife populations are linked to those of the southern Rift Valley and Amboseli regions and sizeable populations of large ungulates still occur in some places, as well as large carnivores including lion *Panthera leo*, leopard *Panthera pardus*, cheetah *Acinonyx jubatus*, spotted hyena *Crocuta crocuta*, striped hyena *Hyaena hyaena*, aardwolf *Proteles cristata* and African wild dog *Canis pictus* (S. Shema, unpub. data). Wildlife movements, however, have become heavily restricted due to land sub-division and infrastructure development in recent years (Ogutu *et al.* 2013).

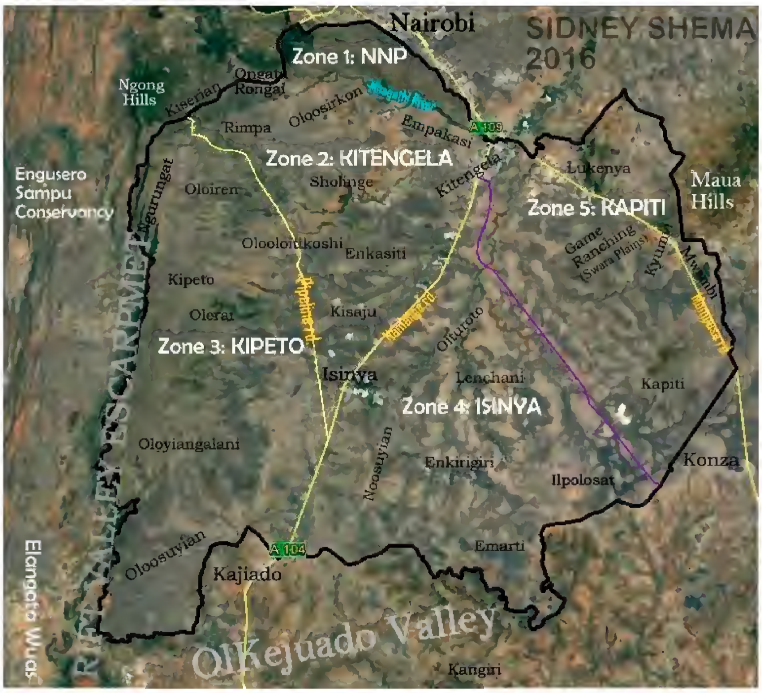

Figure 1. The study area divided into five zones. The Mbagathi River separates zones 1 and 2; the Namanga and Pipeline roads separate zones 2, 3 and 4; and the old railway (purple line) separates zones 4 and 5.

The vegetation is generally open wooded savanna, ranging from shrubby plains to open grassland with scattered trees. The density and height of the woody vegetation varies greatly depending on soil type, altitude, precipitation, and slope. Thin strips of riparian woodland dominated by *Acacia kirkii* and *A. xanthophloea* occur along several rivers and drainage lines. There is a small patch of Afromontane evergreen forest in the northwestern corner of Nairobi National Park (NNP).

Towns and settlements are associated with the major roads (Mombasa, Namanga, and Pipeline roads). Beyond 4–7 km away from the main roads, the land generally opens up and the density of human infrastructure reduces substantially. This is where most of the remaining wildlife occurs (S. Shema, unpub. data). For ease of analysis, all areas with some degree of active wildlife protection, i.e. anti-poaching patrols, have been classified as 'protected areas'. These are NNP, private ranches and properties in Zone 5 (Game Ranching, Machakos Ranching, Kapiti Plains Estate, Lisa Ranch, New Astra Ranch, Mwambi Ranch, Lukenya Hill and Maanzoni), three conservancies (Olerai, Naretunoi and Rimpa), and the Silole Sanctuary bordering the park (Fig. 2).

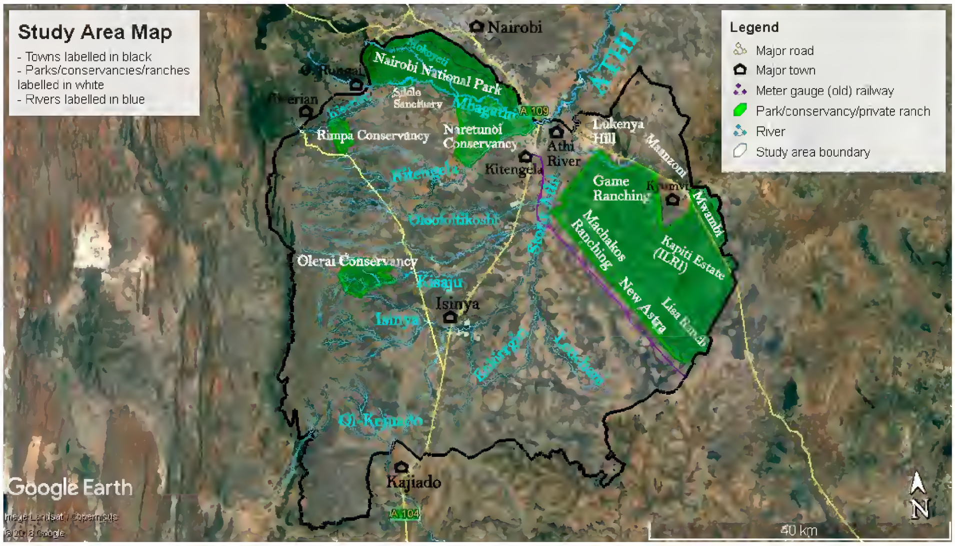

Figure 2. Map showing major towns, drainage lines and protected areas. Lukenya Hill and Maanzoni were also considered protected areas, but their boundaries were not clearly established during preliminary studies, so they were not delineated on the map.

Field surveys

Survey areas were selected based on habitat type, landscape structure, and human presence during preliminary surveys conducted throughout the entire study area in June–October 2016. Areas selected were those judged to offer potentially suitable nesting sites, mainly stands of tall mature trees along riparian zones, large hills and deep valleys/gorges, and having a low density of human infrastructure. Resident raptors were defined as those that breed and/or hold territory within the study area. Nest searches (Bibby *et al.* 2000) were conducted in the selected areas between November 2017 and September 2018. Specific areas surveyed were:

- Zone 1: NNP (NNP) mainly the western, southern and southeastern areas.

- Zone 2: Olooloitikoshi and Kitengela rivers (upper sections). Logistical challenges prevented a survey of the Kiserian Gorge, which may have a few good sites for cliff-nesting falcons.
- Zone 3: Upper sections of the Kisaju River, including Olerai Conservancy, as well as the Isinya, Olkejuado, Oloyiankalani and Ildamat rivers.
- Zone 4: Enkirrgiri, Ilpolosat, Emarti and part of the Lenchani River.
- Zone 5: Game Ranching (Swara Plains), Kapiti Plains Estate, Lisa Ranch, Machakos Ranching, New Astra Ranch, Lukenya Hill, Mwambi Ranch.

Surveys were done on foot along rivers and drainage lines (outside of NNP) and by vehicle along roads both inside and outside NNP. Motorbikes were sometimes used to access areas with poor road networks. Movement was slow during vehicle surveys with an average speed of 7.8 km/h to maximize the chances of detecting raptors (Murn & Holloway 2016). Surveys typically began in the early morning (07:00–08:00) and lasted 3–8 h depending on the size of the area. Twenty-nine surveys were conducted over the 11-month period, covering a total distance of 745.8 km, which comprised sub-surveys of 85.8 km, 73.9 km, 124.4 km, 116 km, and 345.7 km for zones 1, 2, 3, 4 and 5 respectively. No areas were surveyed twice to avoid double-counting of resident pairs.

Observations were made using binoculars and a spotting scope. Photographs were taken where possible to help with the identification of difficult species. Only pairs observed at a nest or displaying breeding, nuptial, or territorial behaviour were counted, as only these can be positively ascertained to be breeding pairs. Nestlings and incubating individuals were also considered evidence of a breeding pair. Any unoccupied and unidentified nests were recorded as 'unidentified'. Individuals that did not present clear evidence of being a resident breeding pair were not included, but were recorded as occurrence data for the species. All nests were recorded according to species and GPS coordinates were taken. Coordinates (as well as data on driving speed and distance travelled) were collected using the Geo Tracker mobile app, while details of raptor observations were recorded using the Global Raptor Impact Network (GRIN) app. Results are presented in terms of the number of nests and breeding pairs recorded for each species in each zone. A map of nest locations is not included to prevent potential human interference at the sites.

Note that no surveys were done at night, as the main focus was on diurnal raptors. The results are thus biased against nocturnal raptors (owls). Occurrence records from preliminary surveys in 2016 and a few secondary records from other observers, including from Kenya Bird Map and eBird databases (only where records could be verified with photos or other information), have been included to contribute to occurrence data.

Other notable observations in the field, such as interesting behaviour or conservation threats, were also recorded. Non-raptorial birds were opportunistically recorded on the BirdLasser app to support the Kenya Bird Map project. All maps were produced using Google Earth and Picasa. Zones are referred to in capital letters to avoid confusion with localities of similar names (e.g. KITENGELA and Kitengela). Taxonomy and nomenclature follow the *Checklist of the Birds of Kenya* 4th edition (Bird Committee, EANHS 2009). All photos are by the author unless otherwise noted.

Results

I recorded 135 resident raptor pairs in the area, belonging to 20 species. Of these, four species are globally threatened: Secretarybird *Sagittarius serpentarius* Vulnerable, Martial Eagle *Polemaetus bellicosus* Vulnerable, Lappet-faced Vulture *Torgos tracheliotus* Endangered, and White-backed Vulture *Gyps africanus* Critically Endangered. Two species are considered Near Threatened: Bateleur *Terathopius ecaudatus* and Crowned Eagle *Stephanoaetus coronatus*, and the remaining 14 species are of least concern. A further 26 non-resident species were recorded, from field surveys and secondary data, making a total of 46 species recorded in the area. The majority of these species (93%, n=43) were diurnal raptors, and three (7%) were owls. Three of the non-resident species recorded were threatened: Rüppell's Vulture *Gyps rueppellii* Critically Endangered, Steppe Eagle *Aquila nipalensis* Endangered, and Greater Spotted Eagle *Aquila clanga* Vulnerable. One species is considered near threatened: Pallid Harrier *Circus macrourus*. I recorded 138 nests, of which 103 (75%) belonged to Threatened or Near Threatened species (Table 1).

The majority of nests were within protected areas (84%, n=116) with 45 (32%) in NNP, 27 (20%) in Olerai Conservancy, and 44 (32%) in the KAPITI ranches. Of the 22 nests outside protected areas, 14 (64%) were in KIPETO alone, while five (23%) were in KITENGELA and three (13%) were in ISINYA. The only nest of a threatened species found outside a protected area was a Martial Eagle nest located in KIPETO.

Table 1. Raptors recorded in the study area, with number of nests and pairs indicated for each resident species. Species without nests or pairs were considered non-resident. Note, a few of these may be resident but pairs were not detected. IUCN Red List status is indicated for threatened and near threatened species. PM = Palaearctic Migrant; am = partial Afrotropical Migrant; CR = Critically Endangered; EN = Endangered; NT = Near Threatened; VU = Vulnerable.

	NNP		KIPETO		KAPITI		KITENGELA		ISINYA		Total Count	
Species	Pairs	Nests	Pairs	Nests	Pairs	Nests	Pairs	Nests	Pairs	Nests	Pairs	Nests
Falconidae												
Lesser Kestrel *Falco naumanni* PM											0	0
Common Kestrel Falco *tinnunculus* (ssp. *tinnunculus* PM; *rufescens*)			1								1	0
Amur Falcon *Falco amurensis* PM											0	0
Eurasian Hobby *Falco subbuteo* PM											0	0
Lanner Falcon *Falco biarmicus*							1				1	0
Peregrine Falcon *Falco peregrinus* (ssp. *minor*)			1								1	0
Accipitridae												
Secretarybird *Sagittarius serpentarius* VU	2	2			1	1					3	3
European Honey Buzzard *Pernis apivorus* PM											0	0
Bat Hawk *Macheiramphus alcinus*											0	0
African Black-shouldered Kite *Elanus caeruleus*											0	0
Black Kite *Milvus migrans* (ssp. *migrans* PM; *parasitus*)			1								1	0
African Fish Eagle *Haliaeetus vocifer*	2				1						3	0
Palm-nut Vulture *Gypohierax angolensis*											0	0
White-backed Vulture *Gyps africanus* CR	31	37	17	21	22	35					70	93
Rüppell's Vulture *Gyps rueppellii* CR											0	0
Lappet-faced Vulture *Torgos tracheliotus* EN	1	1									1	1
Black-chested Snake Eagle *Circaetus pectoralis*			3								3	0
Brown Snake Eagle *Circaetus cinereus*											0	0
Bateleur *Terathopius ecaudatus* NT		1									0	1
Western Marsh Harrier *Circus aeruginosus* PM											0	0
Pallid Harrier *Circus macrourus* PM NT											0	0
Montagu's Harrier *Circus pygargus* PM											0	0
African Harrier-Hawk *Polyboroides typus*											0	0
Eastern Chanting Goshawk *Melierax poliopterus*			1								1	0

Species	NNP		KIPETO		KAPITI		KITENGELA		ISINYA		Total Count	
	Pairs	Nests	Pairs	Nests	Pairs	Nests	Pairs	Nests	Pairs	Nests	Pairs	Nests
Gabar Goshawk *Micronisus gabar*			4	2	1		1				6	2
African Goshawk *Accipiter tachiro*											0	0
Shikra *Accipiter badius*											0	0
Little Sparrowhawk *Accipiter minullus*											0	0
Great Sparrowhawk *Accipiter melanoleucus*											0	0
Lizard Buzzard *Kaupifalco monogrammicus*											0	0
Common Buzzard *Buteo buteo vulpinus* PM											0	0
Augur Buzzard *Buteo augur*			9								9	0
Greater Spotted Eagle *Aquila clanga* PM VU											0	0
Tawny Eagle *Aquila rapax*	1		8	4	4	3	1	3	1	1	15	11
Steppe Eagle *Aquila nipalensis* PM EN											0	0
Verreaux's Eagle *Aquila verreauxii*			1	1	1	1					2	2
Wahlberg's Eagle *Aquila wahlbergi* am											0	0
African Hawk Eagle *Aquila spilogaster*			4	2	1		1	1			6	3
Booted Eagle *Aquila pennata* PM											0	0
Ayres's Hawk Eagle *Aquila ayresii*	1										1	0
Martial Eagle *Polemaetus bellicosus* VU	1	1	2	2	2	2					5	5
Long-crested Eagle *Lophaetus occipitalis*											0	0
Crowned Eagle *Stephanoaetus coronatus* NT	1										1	0
Unidentified raptor		2		6		2				2	0	12
Tytonidae												
Barn Owl *Tyto alba*											0	0
Strigidae												
Spotted Eagle Owl *Bubo africanus*											0	0
Verreaux's Eagle Owl *Bubo lacteus*	1	1	3	3			1	1			5	5
Total	41	45	55	41	33	44	5	5	1	3	135	138

Species accounts

Below are detailed accounts for each resident species, and a few notable non-residents based on field notes and some secondary data. A few historical records (prior to 2016) have also been incorporated in the accounts of some species to add context where relevant. Owls are not discussed because of the sensitivity of information on their locations. References to the specific locations of nests and breeding pairs are also limited, for similar reasons.

Common Kestrel *Falco tinnunculus*

The resident race *F.t. rufescens* is present, but rare, along the Rift Valley escarpment in KIPETO. One pair was observed briefly in the Oloyiangalani area, near the site of the planned wind power project, November 2017. The birds were distinguished from the numerous migrant *F.t. tinnunculus* individuals seen by a much darker and heavily marked appearance both above and below. No photograph was obtained.

Lanner Falcon *Falco biarmicus*

The most common and widespread falcon. It was seen in several locations, but only one definite pair was recorded in KITENGELA, where two adults were seen flying together with a juvenile. This species likely nests along the Rift Valley escarpment. Sightings of juveniles and hunting adults in KAPITI suggest that a pair or two are likely resident around Lukenya, Kapiti and/or Mwambi hills, but no conclusive evidence for this was found.

Figure 3. Lanner Falcon *Falco biarmicus* adult (left) and juvenile (right). KITENGELA, 5 September 2018.

Peregrine Falcon *Falco peregrinus*

Much rarer than the Lanner Falcon, a few records from KIPETO and NNP. One resident pair of the African race (*F.p. minor*) is resident along the upper Isinya River, KIPETO. This species likely nests along the Rift Valley escarpment.

Secretarybird *Sagittarius serpentarius*

Widespread, although rare in the hilly uplands near the escarpment. All nests were on the plains, not along drainage lines, and well-hidden in the canopy of thick *Balanites* trees. Three nests were recorded. A nest on Game Ranching was active in June 2016, when found during preliminary surveys, but it was inactive when checked in April 2018. Two nests were found in NNP in 2018. One was active with an adult incubating (5 May), while the other had a pair seemingly still building (12 Aug).

Figure 5. Secretarybirds *Sagittarius serpentarius* on nests in NNP, 5 May 2018–left, and 12 Aug 2018–right.

Bat Hawk *Macheiramphus alcinus*

An unmistakable immature was seen flying into Hyrax Valley in NNP on September 2017. An adult was seen, also in flight, in a deep rocky gorge along the Kisaju River in Olerai Conservancy, KIPETO, November 2017. No pairs were observed, but the two sightings suggest that there are possible resident pairs in or near KIPETO and NNP. The crepuscular habits of this species make it hard to find.

Black Kite *Milvus migrans*

Resident *M.m. parasitus* (Yellow-billed Kite) was common in all the major towns. No attempt was made to count the number of pairs in towns. It was uncommon away from towns and settlements. One nesting pair was recorded near Olerai, KIPETO, November 2017.

African Fish Eagle *Haliaeetus vocifer*

It was most common in NNP but was also recorded outside the park at large dams in KAPITI and ISINYA. There was one record from Naretunoi Conservancy, KITENGELA. Two pairs are in NNP, one in the north at Nagolomon and Hyena dams, and the other in the south at the Athi Basin dam. It is unclear whether individuals seen along the Mbagathi River inside the park are of the pair from Athi dam. One pair is resident at Game Ranching, KAPITI. Surprisingly, no nests of this species were recorded, despite first year juveniles being seen in NNP.

Palm-nut Vulture *Gypohierax angolensis*

A vagrant to NNP. One immature was seen on 2 and 14 July 2017. These were the third and fourth ever records of this species in NNP. Two other previous records within the last five years or so (dates unspecified) were also of young dispersing birds (B. Finch, pers. comm).

Figure 6. Immature Palm-nut Vulture *Gypohierax angolensis* in NNP, 2 July 2017 (photo: Vishv Patel).

White-backed Vulture *Gyps africanus*

The Athi-Kaputiei area is undoubtedly an important breeding site for this critically endangered species. A total of 93 nests has been recorded, distributed across three nesting colonies: one in NNP with 37 nests, one in KAPITI with 35 nests and a third sizable colony in Olerai Conservancy with 21 nests. The Olerai colony (called the Karibu Colony by some) is within 10 km of a proposed wind energy project and is therefore likely to be at high risk due to collision with turbines and/or power lines once the facility is operational. Non-breeding birds may roost far from these colonies. Large roosts have been recorded in KITENGELA and KIPETO. Old abandoned nests along the Ol-Kejuado and Oloyiangalani rivers show that this species previously had a few other nest sites in KIPETO until very recently. Human disturbance and cutting of large trees seems to have driven them from these breeding sites. Illegal logging has been documented at Olerai and is a continued threat to the breeding colony. Potential natural gas exploration at Olerai is also a threat. Retaliatory poisoning of large carnivores has not been reported often within the study area, but livestock depredation, mainly by spotted hyena and leopard, but also by lion, cheetah and African wild dog is a frequent occurrence in all zones except NNP (S. Shema, unpub. data). The potential to resort to poisoning is therefore always present and is a threat to scavenging raptors, especially White-backed Vultures. It would therefore make sense for livestock protection measures to be included in a conservation strategy for this species. Compared to other large raptors, this species is quite tolerant of human activity near its nesting sites.

Figure 7. A pair of White-backed Vultures *Gyps africanus* at their nest in KAPITI, 11 September 2018.

Rüppell's Vulture *Gyps rueppellii*

This Critically Endangered cliff-nesting vulture does not breed in the Athi-Kaputiei area, but it is present year-round as a foraging visitor. Soaring birds are not an uncommon sight across the plains, but perched birds are most often seen in southern KIPETO, KAPITI and NNP. Individuals and small groups are often in close association with White-backed Vultures at carcasses, roosts and waterholes used for bathing. It is never as numerous as the preceding species, but birds sometimes congregate in sizeable numbers at large carcasses. Most individuals are likely to have come from the nearby breeding colony at Kwenia in the Rift Valley, but birds from other parts of Kenya (e.g., Hell's Gate) almost certainly also visit the area in their extensive search for feeding opportunities. The Athi Plains are undoubtedly an important foraging area for this species.

Lappet-faced Vulture ***Torgos tracheliotus***

There is one active nest in NNP. Several pairs previously bred on the KAPITI ranches (S. Thomsett, pers. comm.), but all are now extirpated. This species seems much less tolerant of people than the *Gyps* vultures and it has very rarely been seen outside of NNP over the past decade.

Figure 8. A juvenile Lappet-faced Vulture *Torgos tracheliotus* in the nest in NNP, 2 October 2018 (photo: M. Pruiksma).

Black-chested Snake Eagle ***Circaetus pectoralis***

A widespread and common species. Three pairs were recorded in KIPETO, two in Olerai Conservancy and one along the Isinya River, although nests have yet to be located. One unidentified nest along the Isinya River probably belonged to the resident pair of this species.

Bateleur ***Terathopius ecaudatus***

One inactive nest in NNP. Only a solitary male is known to be resident. No adult female was seen for over three years, until one was seen on 5 August 2018 by B. Finch and N. Hunter. Whether she will stay or was just a wanderer is uncertain. A male (possibly the same bird from NNP) was seen soaring over Kapiti Hill on 3 September 2018. There are no other records outside of NNP. Three pairs of Bateleurs were previously resident in KAPITI (S. Thomsett, pers. comm.), but have been extirpated.

Eastern Chanting Goshawk ***Melierax poliopterus***

It is widespread and fairly common south of the Mbagathi River but a very rare visitor to NNP. One pair was recorded in the Ngito area of KIPETO. Numerous sightings of birds in all zones except NNP suggest the presence of several resident pairs. No nests have been observed yet.

Gabar Goshawk ***Micronisus gabar***

A widespread and common species in NNP, KAPITI and KIPETO. It is uncommon in KITENGELA and ISINYA. Four pairs were recorded in KIPETO: two pairs, both nesting, were outside of Olerai Conservancy, a third pair was recorded within Olerai but no nest was found, a fourth pair was along the Isinya River (nest not found). A pair was observed mating at Rimpa Conservancy, in October 2016 and another was observed at Kapiti Hill in Sept 2018.

Lizard Buzzard ***Kaupifalco monogrammicus***

One sighting in NNP, August 2017 (N. Hunter & B. Finch, pers. comm.).

Augur Buzzard ***Buteo augur***

Widespread, but most commonly seen in KIPETO and NNP. Nine pairs were recorded in KIPETO. Sightings of an adult and immature at Lukenya Hill indicate a possible pair in the area.

Greater Spotted Eagle *Aquila clanga*

This species has been wintering annually in NNP since Dec 2013. All records are of a single bird, which may in fact be the same individual returning each year (Pearson and Jackson 2016) (Hunter and Finch, pers. comm). A flock of 17 unidentified migrating eagles being hassled by a resident pair of Tawny Eagles *Aquila rapax* in KIPETO in November 2017 were possibly of this species.

Tawny Eagle *Aquila rapax*

The commonest large eagle. It is widespread with at least one resident pair recorded in each zone. Nests have also been located in each zone, except for NNP where an old nest seems to have collapsed. There are three nests belonging to two pairs in Kapiti Estate (one of the nests is on an electricity pylon). There is a pair each on Machakos Ranching and Game Ranching, as well as a pair in Enkirrgiri, Olooloitikoshi, and NNP. There are eight pairs in KIPETO, making it a total of 15 pairs in the study area. Seven (32%) of the 22 raptor nests outside of protected areas belong to Tawny Eagles, more than any other single species. This species is the most tolerant eagle to human presence in the study area.

Verreaux's Eagle *Aquila verreauxii*

One nesting pair at Lukenya and one (reportedly) along the Rift Valley escarpment, KIPETO. A pair in NNP was extirpated well before 2012 (FONNAP 2012). This species is now an extremely rare visitor to NNP. One adult was photographed in the park by N. Diaz on 28 January 2017 near the Mbagathi River. Two other similar reports within a month of this sighting suggest it was the same individual.

Wahlberg's Eagle *Aquila wahlbergi*

A very rare visitor. There have been three recent records. D. Chesire and M. Adamjee recorded one each in KAPITI in February and August 2016, respectively (Kenya Bird Map 2016) and one was seen in September 2017 in NNP (N. Hunter and B. Finch, pers. comm). No records from elsewhere.

African Hawk Eagle *Aquila spilogaster*

It is fairly common in KIPETO, but scarce elsewhere. It is a fairly rare visitor to NNP. There are four pairs in KIPETO, a pair in KAPITI and a pair nesting in KITENGELA. Individuals that are sporadically seen along the Mbagathi River in NNP, including a record of a juvenile in Feb 2017 (Leitão 2017), are most likely from this KITENGELA pair, as the Mbagathi is barely 14 km north of their nest. This species and the Martial Eagle are persecuted as predators of young goats, sheep and chicken in some areas. A homestead within 200 m of a nest reported that in 2017 and 2018 the eagles killed young goats at a rate of about one kill every two weeks for two months after the goats gave birth. There have been failed attempts to shoot the eagles with arrows. I advised the stock owners that they should build an enclosed shelter to keep young goats and sheep inside until they attain a size too large for the eagles, but the pair remains in real danger of being killed in retaliation.

Ayres's Hawk Eagle *Aquila ayresii*

There is one pair in NNP, but their nest is yet to be located. This species is absent from the rest of the study area as there is no suitable forest or dense woodland habitat.

Martial Eagle *Polemaetus bellicosus*

It is widespread, but rarely seen in KITENGELA and ISINYA. There is one nesting pair in NNP, two nesting pairs in KAPITI and two nesting pairs in KIPETO. Only one nest is outside a protected area. This nest is within the Kipeto Wind Power site and hence the pair is at high risk of collision with the turbines or power lines once they are constructed and operational. Another pair is also at high collision risk as it is within 10 km of another proposed wind power site along the escarpment. Anecdotal accounts from several local residents suggest that persecution as a livestock predator is a potentially significant limiting factor in the abundance and distribution of nesting pairs outside of protected areas. Some areas of ISINYA, for instance, seem ideal for Martial Eagles, but the species is absent. A field collaborator reported that an adult Martial Eagle with a metallic ring was found dead under a tree in Ildamat in September 2017 and is suspected to have succumbed to poisoning. This was most likely secondary poisoning, however, as accounts from local people indicate, retaliation against this species is usually done by shooting it with arrows or spears. This bird was probably one of several individuals ringed in KAPITI in the 1990s and in 2012 (S. Thomsett and S. Kapila, pers. comm.).

Figure 10. Juvenile Martial Eagle *Polemaetus bellicosus* in KIPETO, 23 November 2017.

Crowned Eagle *Stephanoaetus coronatus*

One pair is resident in NNP, but its breeding status is uncertain. It is absent from the rest of the study area because of lack of suitable forest habitat.

Discussion

Generally, several raptors are known to have more than one nest site within their territory or home range and can alternate between these during different seasons (Newton 1979, Leonardi 2015). In any given season, there will also be pairs whose breeding attempts fail early and thus may not be detected when their nests are visited (Newton, *op cit.*). This likely explains the surplus of nests in relation to the number of breeding pairs of White-backed Vultures, as well as the 12 unidentified nests and several pairs whose nests were never located (Table 1). Some of the unidentified nests certainly belong to some of these pairs.

Zone 3 (KIPETO) had the highest number of nests outside protected areas and is the only zone where a threatened species was recorded nesting outside a protected area. All nests in KIPETO are distributed from Olerai Conservancy southward. The area north of Olerai was observed to have fairly dense human settlement and notably degraded habitat during preliminary surveys and was considered unsuitable for most resident raptors and other wildlife. The protected areas are clearly the most important areas for the six species of threatened and near threatened raptors in the study area. No nests were found on Naretunoi and Rimpa conservancies, but the presence of wildlife, few human settlements, and anti-poaching patrols means that they are undoubtedly important feeding areas for some of the resident raptors as well as potentially important stop-over and wintering areas for migratory raptors.

Data from this study can be used as a baseline for future long-term monitoring of resident raptor populations as infrastructure development and other factors continue to influence the area's ecological structure. This, however, is unquestionably a shifted baseline, as true baseline data on the area's original raptor guild would need to have been collected several decades ago before the area began to be industrialized and urbanized.

Conclusion

The data indicate that NNP, KAPITI and southern KIPETO are the most important areas for the conservation of resident raptors in the Athi-Kaputiei Ecosystem. The threatened species, in particular, are almost entirely dependent on these three areas for nesting sites. Plans to build wind energy facilities in KIPETO (Kipeto Energy Ltd. 2012) make the long-term conservation of the Olerai White-backed Vulture colony a challenge. A planned expressway from Nairobi to Mombasa is likely to be built through some of the KAPITI ranches and this will also add to the challenges of raptor conservation in this key area. The construction of Phase 2 of the Standard Gauge Railway through NNP is nearly complete and the long-term impact of this mega-structure on the park's raptors remains to be seen. Close monitoring of raptors in all of these areas, especially once the facilities and structures are operational, will be vital in order to minimize the impacts of these developments on the area's raptors. Any plans for future developments in this area must also include conservation measures in their initial strategies and relevant wildlife experts be consulted extensively, from the planning to the implementation phases.

Protected areas in KITENGELA (Naretunoi and Rimpa) and open unprotected areas in southern ISINYA (Lenchani, Enkirrgiri, Noosuyian, Ilpolosat, Emarti) have few nests, but they do support prey populations in the form of game birds, several mammals and other wildlife (S. Shema unpub. data). They undoubtedly serve as feeding areas for some of the resident raptors, including pairs nesting in the protected areas. Migratory species also use these areas. These are thus key areas that need conservation attention as the Athi-Kaputiei area develops. Working with local livestock owners on simple solutions to protect their young stock from large raptors is a necessity in areas with nesting Martial and African Hawk Eagles. Livestock protection against large mammalian carnivores to prevent retaliatory poisoning is also important, particularly for the large numbers of resident Critically Endangered White-backed Vultures.

Any conservation strategies that will be drawn for the Athi-Kaputiei area need to consider one very important factor, the conflict of interest among land owners. This is especially significant for the unprotected areas. Finding ways that allow land owners to benefit from their land while still coexisting with raptors and other wildlife, especially large predators, is perhaps the greatest and most important challenge in this area. Further research is needed on ways to address it. It is this challenge that conservation practitioners must focus on solving first if the resident raptors, especially the numerous breeding pairs of threatened species, are to continue to exist in the area over the long term.

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Short communications

New breeding records and observations of the Peregrine Falcon *Falco peregrinus minor* from Ethiopia

The Peregrine Falcon *Falco peregrinus* is represented in sub-Saharan Africa by two subspecies, *F.p. minor* and *F.p. calidus*. While the latter is encountered as a winter visitor and passage migrant only, the largely sedentary *minor* (Fig. 1) covers a broad breeding range across sub-Saharan Africa (Ferguson-Lees & Christie 2001, Dickinson & Remsen 2013, del Hoyo & Collar 2014, Gedeon *et al.* 2017). In the Horn of Africa, members of this subspecies are regularly – though infrequently – observed (Ash & Miskell 1998, Ash & Atkins 2009). However, breeding was recorded only very rarely in a few localities: so far, there are only two confirmed breeding records of *minor* from Ethiopia, another 'probable', and one from Eritrea (Ash & Atkins 2009). Here we present two confirmed and a potential third recent breeding record as well as three other observations of *minor* from Ethiopia.

Figure 1. Appearance and identification of the Peregrine Falcon *Falco peregrinus minor*. **a)** Adult female hunting. Besides its compact body, the overall dark upper side and the broad moustachial streak contrasting with the light cheeks differentiate the subspecies *minor* from *calidus*; the same individual as on Fig. 2i (Photo: T. Pröhl; Bishangari Lodge, Lake Langano, Oromia Regional State, Ethiopia; 26 November 2014). **b)** Adult male. As typical of Peregrines, males are smaller and appear less sturdy than females (Photo: T. Pröhl; Bishangari Lodge, Lake Langano, Oromia Regional State, Ethiopia; 8 November 2013).

One breeding record was made by KG and TT on 19 May 2013 near the town of Mega in the Oromia Regional State in Southern Ethiopia. We observed two adult birds, a female (Fig. 2a) and a male (Fig. 2b), flying and perching between the bare rocks rising above the surrounding savanna. We could clearly ascertain their subspecific identity as *minor* by their small size, dark overall appearance and head pattern consisting of a dark crown and broad moustachial streaks contrasting with white cheek-patches, unlike *calidus*. Following the birds, we found them entering a hidden nesting site on a sparsely vegetated cliff ledge from where we could also hear the typical begging calls of nestlings (Fig. 2c). The adults were apparently provisioning their offspring with food, although we were unable to see the juveniles because of the position of the nest in a hidden corner of the rock.

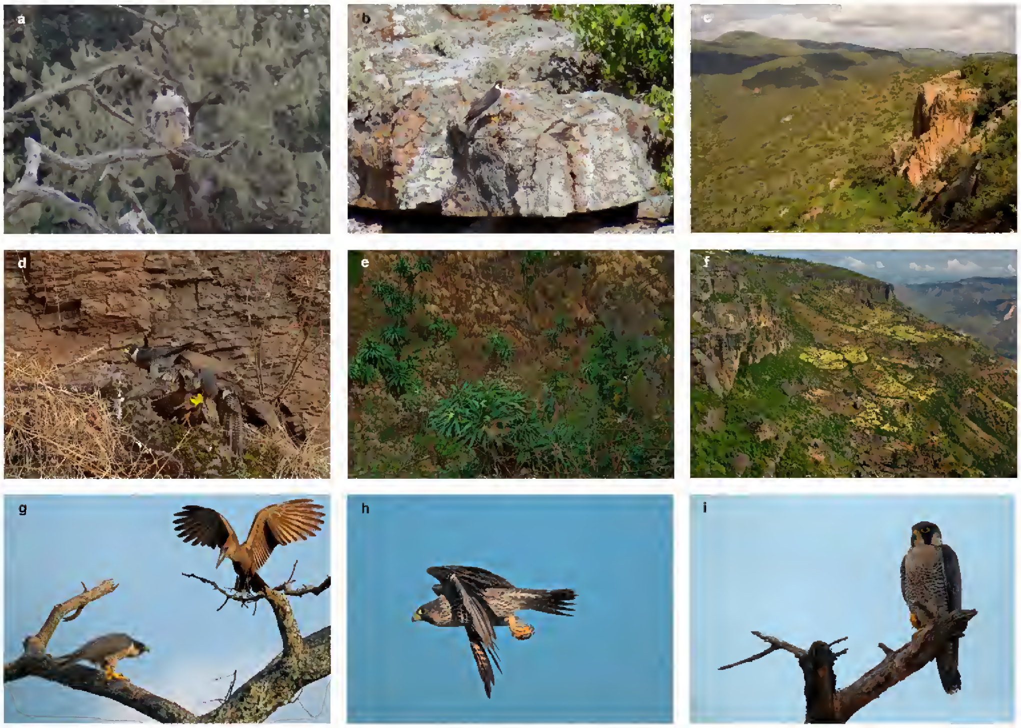

Figure 2. Breeding records, breeding sites and observations of the Peregrine Falcon *F.p. minor*. **a)** Adult male perched on a branch of a dead tree on the cliff close to the nesting site near Mega (Photo: K. Gedeon; near Mega, Oromia Regional State, Ethiopia; 19 May 2013); **b)** Adult female roosting on the cliff close to the nesting site near Mega (Photo: K. Gedeon; near Mega, Oromia Regional State, Ethiopia; 19 May 2013). **c)** Breeding habitat of *minor* in the Mega area, seen from the top of the rocks that rise above the savanna. The nesting site is hidden in the cliff on the right in the foreground (Photo: T. Töpfer; near Mega, Oromia Regional State, Ethiopia; 19 May 2013). **d)** Nesting site of *minor* in a cliff in the Wondo Genet Forest. The male is visible in the background, the female in the foreground is seen carrying a Yellow Wagtail *Motacilla flava* as food for the two approximately two-week-old nestlings also visible to the left (Photo: T. Pröhl; Wondo Genet Forest, SNNP, Ethiopia; 14 March 2014). **e)** Breeding habitat of the Peregrine Falcon *F.p. minor* in the Wondo Genet Forest. Note the dense vegetation close to the nesting site. (Photo: T. Pröhl; Wondo Genet Forest, SNNP, Ethiopia; 14 March 2014). **f)** Presumed breeding habitat of *minor* in the Debre Libanos area, occupied by a territorial pair (Photo: T. Pröhl; Debre Libanos, Oromia Regional State, Ethiopia; 6 November 2011). **g)** Adult female quarreling with a Hamerkop *Scopus umbretta* (Photo: T. Pröhl; Awassa lakeside promenade, Awassa, SNNP, Ethiopia; 9 October 2012). **h)** Immature female flying off from its perch. Note the heavy streaking on the bird's underside indicative of its age (Photo: T. Pröhl; Bishangari Lodge, Lake Langano, Oromia Regional State, Ethiopia; 8 November 2013). **i)** Adult female resting from hunting; the same individual as shown in Fig. 1a (Photo: T. Pröhl; Bishangari Lodge, Lake Langano, Oromia Regional State, Ethiopia; 26 November 2014).

Another breeding record was made by TP and Silvio Herold on 13 to 15 March 2014 in the Wondo Genet Forest in the Southern Nations, Nationalities and Peoples Region (SNNP) in Southern Central Ethiopia. The adult birds observed were likewise identified as *minor* based on the same characters as described above (Fig. 2d). The nesting site was situated on a small cliff ledge of a north-facing rock with trees rising

up directly in front of the cliff (Fig. 2e). The nest contained two nestlings that were approximately 14 days old. We could observe the adults twice feeding their young with Yellow Wagtails *Motacilla flava* (Fig. 2d). The falcons did not appear shy and let us approach closely. Interestingly, there was a nesting site of a Crowned Eagle *Stephanoaetus coronatus* just 150 m away, although the previously observed eagle nestling had disappeared by 13 March.

A third observation, again made by TP and Silvio Herold, led us to presume breeding of *minor* in a cliff near Debre Libanos in the Oromia Regional State in North Central Ethiopia. There was a pair of phenotypically *minor* Peregrines that behaved like a territorial pair, performing characteristic courtship displays and chasing a pair of Lanner Falcons *F. biarmicus* from the cliff. We recorded the Peregrine pair each day from 17 to 19 March 2014 approaching the very same cliff, and we therefore concluded that the pair apparently occupied this territory (Fig. 2f) and that breeding was very likely there, although we did not find the nest site itself.

There are three more records of *minor* Peregrines from Ethiopia made by TP. An adult bird was perched in a withered tree on Awassa lakeside promenade in Awassa on 9 October 2012, where it was mobbed by a Hamerkop *Scopus umbretta* (Fig. 2g). Two individuals, an adult male (Fig. 1b) and an immature female (Fig. 2h), who were—independent of each other—observed perching on and hunting around Bishangari Lodge at Lake Langano on 8 November 2013. At the same site, an adult female was observed hunting on 26 November 2014 (Figs. 1a, 2i).

Our observations add two more and a likely third breeding record of the Peregrine Falcon *F.p. minor* to the avifaunal documentation of Ethiopia. Considering the scarcity of properly documented breeding events of *minor* in the Horn of Africa and the long timespan since the last dated record (5 May 1998; Ash & Atkins 2009), our recent records are notable for the region. This also holds true for simple observations of Peregrines if reliably identified on subspecies level. We are convinced, however, that a certain number of observations made by ornithologists travelling in the area may simply not have been published and thus we would like to motivate our colleagues to properly document their past and present observations for the sake of long-term avifaunal documentation.

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The first documented record of Western Reef Heron *Egretta (gularis) schistacea* for Tanzania

On 4 March 2012 the four of us were birding at one of our regular spots on the coast at Bagamoyo. It was a wet day and we had retreated early from the adjacent salt pans to the Livingstone Hotel. While waiting for breakfast we scanned the intertidal flats and NEB soon located an unusual egret feeding in shallow water some 200 m away that he suspected was a Reef Heron.

RM and SW walked out with their cameras and managed to take excellent photographs which were submitted to the East African Rarities Committee and accepted (Fisher & Hunter 2016; Fig. 1).

Figure 1. Western Reef Heron at Bagamoyo (photo: R. Marais).

All four of us are familiar with the Little/Dimorphic Egrets *Egretta garzetta/dimorpha* that are resident along the Tanzanian coastline. We have all spent considerable time over the years debating this species complex and discussing ways of separating white-plumaged birds that could be either *E. garzetta* or *E. dimorpha*. While none of us has ever reached a firm conclusion, we all realized that the white-plumaged bird before us was clearly different from anything we had seen before along this coast.

As the bird walked closer to us, we could clearly see differences in structure and jizz, most notably the bill shape, colour and size. We are all familiar with the wide variations in the extent of 'colour' on the legs of *E. dimorpha* and did not pay too much attention to this feature.

Britton (1980) did not include *E. gularis* for Tanzania, giving both inland and coastal records of the race *E. g. asha* for Kenya. Dowsett (1993) includes *E. gularis* in his annotated country checklist for Tanzania but without comment.

For interesting discussions on these coastal egrets, refer to Pakenham (1979), Hancock & Kushlan (1984) and Turner (2010, 2014).

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A Little Green Sunbird *Anthreptes seimundi* from Minziro Forest Reserve: the first documented record for Tanzania

On 27 January 2018 I was camped below a large mature fig tree adjacent to an abandoned track on the western edge of Minziro Forest Nature Reserve at 1°05′ S, 31°25′ E.

The fig was fruiting and busy with birds and both Grey-cheeked Mangabey *Lophocebus albigena* and the *dogettii* race of the Blue Monkey *Cercopithecus mitis*. African Green Pigeons *Treron calvus* were numerous, with Great Blue Turaco *Corythaeola cristata*, Yellow-spotted Barbet *Buccanodon duchaillui*, Yellow-rumped Tinkerbird *Pogoniulus bilineatus*, Spotted Greenbul *Ixonotus guttatus*, Slender-billed Greenbul *Andropadus gracilirostris*, and Black-and-white Casqued Hornbill *Bycanistes subcylindricus* present in varying numbers. On the following morning I photographed what I believed to be a Little Green Sunbird *Anthreptes seimundi* in the canopy of the fig tree. There were at least three, but I was concentrating on obtaining photographs and did not note exactly how many were present. Four of the photographs were submitted to the East African Rarities Committee and were accepted as the first record for Tanzania. One of these images is Fig. 1.

The basic green colour, the yellow base to the lower mandible, the size of the bird, length of bill, habitat, and behaviour all fit what is known of this bird.

Figure 1. Little Green Sunbird in Minziro Forest Reserve (photo: N. Baker).

The Ugandan Atlas (Carswell *et al.* 2005) includes Malabigambo FR in the range of this species quoting Friedmann & Williams (1969). Malabigambo FR is contiguous with Minziro Forest Reserve—essentially it is the same forest. The international border at one degree South passes through the forest.

In July 1987 we caught another bird that I thought was this species, but unfortunately suitable photographs were not taken. Without doubt, this species is a low-density resident in Minziro Forest Reserve even though I did not find it during my earlier visits in 1993, 2000 and 2016.

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A concentration of Lappet-faced Vultures *Torgos tracheliotos* in the Ngorongoro Conservation Area, Tanzania and the latest Atlas map

Continent wide, vultures are in trouble (Ogada *et al.* 2016), but the large protected areas in Tanzania continue to support impressive numbers. On 12 February 2013, the four of us were birding on the track from Ndutu to the Eyasi Rift. At 3°10′ S, 34°53′ E we stopped to watch four Lappet-faced Vultures *Torgos tracheliotos* on a dead tree in the open woodland. The vegetation was quite dense, with acacias in leaf and the grass high, but we quickly found a few more birds in the nearby trees and by searching as best we could without leaving the road, we counted a minimum of 31 birds concentrated in an area some 100 m from the track. OTB obtained the highest single count by standing on the roof rack for a better view. We could not locate whatever they were feeding on, but there were no other vultures present, which we considered unusual, so perhaps it was a natural death of a large mammal whose body had not yet been opened up by the Lappets. Further along the track we found another 1, 4, 4 and 1 Lappets, suggesting a minimum of 41 in the immediate vicinity.

Britton (1980) gives only 10–12 seen on carcasses in the Serengeti NP. Mundy *et al.* (1992) give a count of 47 at a waterhole in the Namib Desert, 26 on a pan in the Kalahari, Botswana, 30 twice in Zimbabwe, 26 on a dead Ostrich *Struthio camelus* in Namibia, and 21 on a drowned Wildebeest *Connochaetes taurinus* in Tanzania.

The latest Atlas map for this species in Tanzania clearly confirms the importance of large protected areas and their populations of large mammals (Fig. 1). The knowledge gaps within the system of Protected Areas simply relates to the lack of fieldwork within Game Reserves that are restricted for commercial hunting and are, sadly, data-deficient.

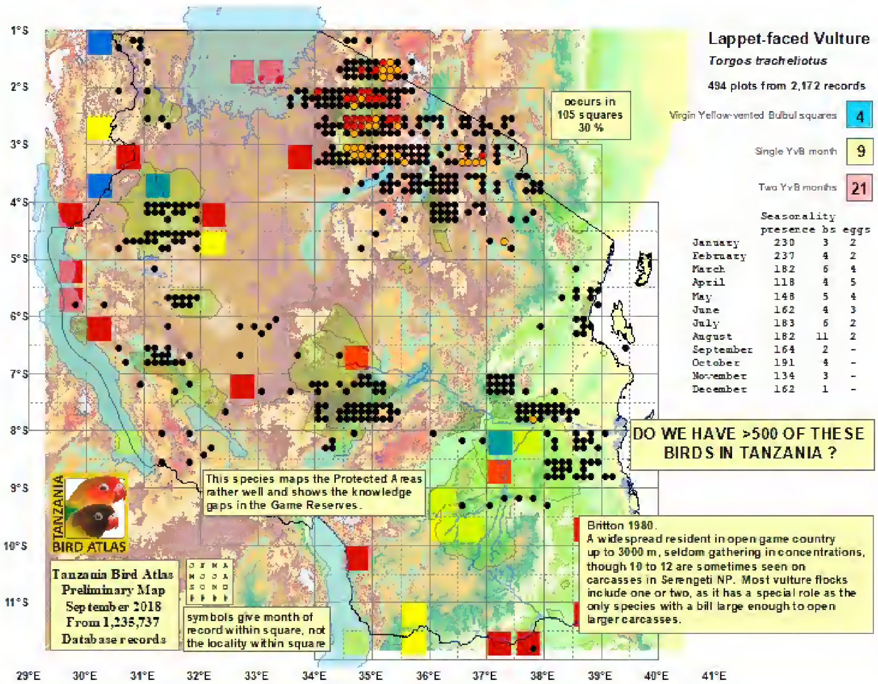

Figure 1. This map represents nearly 40 years of data collection. As yet there are no obvious signs of a population decline, perhaps because this species was always associated with the larger protected areas, which have largely remained intact.

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Chubb's Cisticola *Cisticola chubbi* near Bukoba, Tanzania

Keith (1993) discussed in some detail the location of two Chubb's Cisticola *Cisticola chubbi* specimens collected by Grauer in 1907 that have consistently been referred to as from Bukoba. In fact, they were taken near Karagwe in what was then Bukoba District, some 80 km west of Bukoba. The conclusion reached was that these birds did not occur close to Bukoba but in higher country well to the west.

On 29 January 2018 we found this species at two localities on the road from Kamachuma to Nshamba at 1°42′S 31°34′E and 1°45′S 31°33′E (Fig. 1). The habitat was herbaceous vegetation with low bushes alongside small streams in an area of low-density cattle grazing and village-level agriculture. These sites, at an altitude of 1450 m, are only 6 km apart on different streams and only 16 km from Lake Victoria and 47 km south-southwest of Bukoba town. There is no reason to believe that these were the only pairs in what is an extensive network of small streams merging into highland swamps in an area of quite high human population density.

Figure 1. Chubb's Cisticola (photo: N. Baker).

The Tanzania Atlas database holds records from Ngara and Kabanga close to the Rwandan border from September 1992 (NEB, EMB), and one from the Rovuvu River where it forms the boundary between Tanzania and Burundi, on 29 September 1992 (ZB). There is also a more recent record from the Rwandan side of Rusumo Falls on 13 December 2009 (JA). Haldane (1951) did not record any cisticolas in his three years' residence, not even Trilling *C. woosnami*.

We thank Jason Anderson, Elizabeth Baker, and Zul Bhatia for providing records to the Atlas.

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The Grey-chinned Sunbird *Anthreptes rectirostris* in Tanzania

Britton (1980) lists this species for Malabigambo Forest in Uganda but not for the contiguous Minziro Forest Reserve (FR) forest in Tanzania. This is surely because Minziro FR was poorly known until the 1980s, not having been visited previously by an ornithologist or serious birder. Several forest species are named in Britton from Bukoba and these surely refer to specimens collected in Minziro on behalf of Thorkild Andersen which have yet to be fully documented (Britton 1978). Carswell *et al.* 2005 map a geo-referenced record from the Sango Bay forests on the border with Tanzania but no others nearby which suggests a species occurring at a low density. During our first, rather brief, visit in 1984 (Baker & Hirslund 1987), this species was not found. During our longer second visit in July 1987 it was seen only once, at the forest edge and some distance from our ringing site. Insufficient field notes were taken at the time as we were en route to another site. During our third visit, in November 1993, this species was again seen, once at the edge of Kikuru FR on the east bank of the Kagera River opposite Minziro FR (pers. obs.) and once en route to Bukoba (S. Davies, pers. comm.) In October 1998, D. Moyer (pers. comm.) reported a single bird in Minziro FR. This species was not reported during the July 2000 visit to Minziro FR when a further 365 birds of 59 species were ringed (Baker 2000). In June 2011, S. Clarke (pers. comm.) reported this species from Minziro FR and from Katoke Teachers College near Bukoba at 1°39′S – 31°41′E. The latest record is of a pair on 28 January 2018 on the western edge of Minziro FR (Leons Mlawila and pers. obs.). Clearly, it exists at quite low densities throughout this general area, especially at the forest edge. For various reasons none of these records was submitted to the East African Rarities Committee.

On 19 July 2016, at least one pair was located along a track inside Minziro FR that we had not previously used. These birds were located by Per and Florence Holmen at 1°02′S – 31°30′E. This record has been accepted by the EARC, thus the species can now be formally added to the Tanzania avifauna.

Figure 1. Male Grey-chinned Sunbird *Anthreptes rectirostris*, Minziro Forest, Tanzania, 19 July 2016 (Photo: F. Holmen).

Figure 2. Female Grey-chinned Sunbird *Anthreptes rectirostris*, Minziro Forest, Tanzania, 20 July 2016 (Photo: F. Holmen).

We thank, Stan Davies, Leons Mlawila, David Moyer and Steve Clarke for submitting their records to the Tanzania Bird Atlas, and Florence Holmen for her excellent photographs.

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Common Scimitarbill *Rhinopomastus cyanomelas* parasitized by Greater Honeyguide *Indicator indicator*

In the property L.R. 2327/59, in Nairobi's Langata suburb, between 1968 and 1983, Common Scimitarbills *Rhinopomastus cyanomelas* nested irregularly in a cavity in the bole of an African Olive tree *Olea africana*. The cavity was *c.* 1.5 m above ground, with an observation panel that could be opened and shut in its side. On 23 February 1983, a clutch of three pale greenish blue scimitarbill eggs had been laid. On 25 February, a female Greater Honeyguide *Indicator indicator* was seen leaving the cavity which, on inspection, now contained a white egg of similar size to the scimitarbill's, which I assumed to be the honeyguide's. All three scimitarbill eggs had one small, roughly triangular, hole through the shell about the midpoint of its long axis that had not been there previously (Fig. 1). These damaged eggs were removed leaving the honeyguide egg. However, this was eaten by an Ochre Bush Squirrel *Paraxerus ochraceus* on the following day, after which for the next 28 years for which records were kept, scimitar-bills were never again seen on this property.

Figure 1. Common Scimitarbill *Rhinopomastus cyanomelas* egg punctured by a Greater Honey-guide *Indicator indicator* (photo: P. Davey).

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The first record of Grey Phalarope *Phalaropus fulicarius* for Tanzania

On the morning of 25 June 2014, Meredith Sylvia and I were conducting fieldwork in the Serengeti National Park for the Lion Project. We drove south from Moru Kopjes, tracking the pride that was supposed to be there.

I picked out a small bird on a shallow pool and instantly thought it could well be a phalarope. I drove around to the far side to get closer, and more favourable light. It was quite untidy looking, but it was no doubt a Grey Phalarope *Phalaropus fulicarius* (Fig. 1). I knew the species was supposed to be rare in Tanzania but, after a look in the field guide (Zimmerman *et al.* 1996) it appeared that this might be the first country record. This bird was lost both in space and time. Not only had it missed its usual wintering quarters at sea off the western and southwestern coasts of Africa (Cramp, S. & Simmons, K.E.L. 1983), it wasn't winter anymore, in late June it was supposed to be in the Arctic. There are a few records from the Red Sea (Cramp & Simmons *op. cit.*).

Figure 1. Grey Phalarope *Phalaropus fulicarius*, Serengeti, Tanzania, 25 June 2014 (photo: D. Rosengren).

To ensure that this sighting was recorded properly, I started wading out towards the bird with my camera. It was a large pool and I had to wade quite far out before coming into reasonable distance to take photos. The very alkaline water was only ankle deep, but the bottom clay was extremely slippery, and I struggled to stay upright. The phalarope kindly let me photograph it and I happily returned to the car, very excited.

This record, with photographs (clearly showing the distinctive yellow-based bill), was submitted to the East African Rarities Committee and accepted as the first record for Tanzania. This species is not listed for Uganda (Carswell *et al.* 2005). There are only five records listed for Kenya (Lewis & Pomeroy 1989), two in February, one in March,

one in April and one in September, but some of these are questionable (D.A. Turner, pers. comm.). Ash & Atkins (2009) document a single record for Ethiopia in January 1973. This record from the Serengeti appears to be the first East African record for June when all adults can be expected to still be on their breeding grounds in the High Arctic. It is noteworthy that Dowsett *et al.* (2008) and Dowsett-Lemaire & Dowsett (2006) do not list this species for Zambia and Malawi respectively, nor is it listed by Vande weghe & Vande weghe (2011) for Rwanda. The bird is called the Red Phalarope in North America (in recognition of its breeding plumage) and that name has been adopted by del Hoyo & Collar (2014) as its first choice.

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Comments on two *Myrmecocichla* chats in Tanzania

Glen *et al.* (2011) discussed, in some detail, the plumage variations among *Myrmecocichla* populations in Tanzania, contending that all birds in the humid semi-deciduous forests east and south of the Eastern Arc divide, and including the Nguru Mountains, belong with the White-headed Black Chat (*M. arnotti / leucolaema*) group, while the 'white-collared' *miombo* woodland birds (*collaris*) west of that mountain divide are worthy of a higher rank, and not to be treated as a synonym of *leucolaema*, as done by Dickinson & Christidis (2014) and del Hoyo & Collar (2016).

In 1880, Fischer & Reichenow described *M. leucolaema* from an 1879 specimen reportedly collected by Fischer from the Nguru Mountains. In the description, no type is designated and there are no inventory numbers for specimens. Only one specimen's measurements are given, of a bird from the locality 'Nguru-Berge' [= Nguru Mountains, Tanzania]. The whereabouts of this specimen are unknown, and it it has never been incorporated into the collections of either the Berlin or Hamburg museums (Sylke Frahnert *in litt.*).

Later, Reichenow (1882) described *M. nigra* var. *collaris* from a specimen collected by Richard Böhm at Kakoma in Tabora District in August 1880. At the time, Reichenow considered *M. nigra* and *M. arnotti* to be conspecific, and his view was later supported by Ogilvie-Grant (1908) who considered the forms *leucolaema* and *collaris* to be synonyms of nominate *arnotti* too. As a consequence, the names *leucolaema* and *collaris* effectively disappeared from the ornithological literature until revived by Glen *et al.* (2011).

Morphologically, the two groups (*collaris* vs *leucolaema / arnotti*) are very similar, in fact adult males are identical; although females have white cheeks, it is only the female *collaris* that has an all-white collar. While we agree that this is far from being evidence for full species status (Ruaha Chat, the name given for *M. arnotti leucolaema* in del Hoyo & Collar *op. cit.*), too little attention has been given to the vocalizations of these groups, although on one occasion, birds in Katavi National Park (typical *collaris*) were totally unresponsive to a playback of the call of nominate *arnotti* (Glen *et al.* 2011).

With further studies clearly warranted, particularly on vocalizations and by acquisition of more conclusive molecular data, it is clear that two discrete populations occur either side of the Eastern Arc divide. We suggest that they may best be provisionally considered as two subspecies of the White-headed Black Chat *Myrmecocichla arnotti*: *M. arnotti arnotti* (including *leucolaema*) to the east, and *M. arnotti collaris* in areas to the west of the divide, as defined by Glen *et al.* (2011).

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We wish to thank Don Turner for bringing to our attention the treatment of *collaris* in two recently published world checklists, together with his own comments on this important issue.

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Corrigenda

Werema, C., Howell, K.M., Msuya, C.A., Sinclair, J. & Macha, A. 2016. Birds of Golden Pride Project area, Nzega District, central Tanzania: an evaluation of recolonization of rehabilitated areas. *Scopus* 36(2): 26–36.

In Appendix 1, the list of species should include only one species of lovebird, Fischer's Lovebird *Agapornis fischeri.* Yellow-collared Lovebird *Agapornis personata* was erroneously included and does not occur in the region.

Werema, C. 2017. Preliminary comparison of birds inhabiting exotic Acacia and native bushland habitats in semi-arid east-central Tanzania. *Scopus* 37(2): 32–37.

In Appendix 1, the correct species of lovebird should be Yellow-collared Lovebird *Agapornis personata* and not Fischer's Lovebird *Agapornis fischeri,* which does not occur in the region.

We thank Neil Baker for correcting these errors.

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Units: Metric units and their SI equivalents and abbreviations should be used. The

abbreviation should be preceded by a space, '5 km' not '5km'. Latitudes and longitudes in degrees and minutes, not decimal degrees.

Dates: 21 February 2001 [note the order, no comma, not 21st].

Time of day: 13:00 [note colon, no 'hours', 'hrs' or 'h'; 'h' is a unit of time, not of time of day].

Names of birds: For example, Olive Thrush *Turdus olivaceus* [no comma, no parentheses, no author's name or date (unless pertinent to a point in the text)].

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List references at the end of an article: See the examples below for format. When printed, authors' names appear in capitals and small capitals *but they should be typed in ordinary roman as shown below.*

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Stuart, S.N., Jensen, F.P., Brøgger-Jensen, S. & Miller, R.I. 1993. The zoogeography of the montane forest avifauna of eastern Tanzania pp. 203–228 *in* Lovett, J.C. & Wasser, S.K. (eds) *Biogeography and ecology of the rainforests of Eastern Africa*. Cambridge: Cambridge University Press.

Urban, E.K., Fry, C.H. & Keith, S. (eds) 1986. *The birds of Africa*. Vol. 2. London: Academic Press.

BirdLife International 2013. Species factsheet: *Balearica regulorum*. Downloaded from http://www:birdlife.org on 14/05/2013.

Both English and scientific names of birds should be given when the species is first mentioned — in the title and in the text — thereafter only one name should be used but both English and scientific names should be given in captions to figures.

Bird names should be those of a stated work. Any deviations from this work should be noted and the reasons given.

Black-and-white or colour photographs and line illustrations should be provided as separate graphic files in JPEG or TIFF format. All articles should be submitted by email in Microsoft Word or as a Rich Text Format (RTF) file.

Please send all contributions to
The Editors, *Scopus: Journal of East African Ornithology*, Email:
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Rare birds in East Africa

Records of rare birds from Kenya, Tanzania and Uganda are assessed by the East Africa Rarities Committee. Records from other countries in the region can also be submitted for review and possible publication in *Scopus*. A full account of the record should be sent to the committee Chairman, Nigel Hunter (nigelhunter@timbale.org) and the *Scopus* editors.

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